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EDITORIAL.

WITH this number the Twenty-fifth Volume of KNOWLEDGE is completed. At the close of a year the mind travels naturally back over events and attainments of the past, and the student, old or young, is inclined to raise enquiring eyes from his own occupation to contemplate progress around him.

The certainty of steady progress in science will be felt after such a survey of the year 1902; and if war gives rise to many opportunities for bringing the man of science to the front, at least we may express the conviction that peace following strife gives to science an impetus towards solid advancement. Should KNOWLEDGE in any sense have led its readers during the past year to a participation in the results of the progress of science, the Editors and Contributors alike can be but gratified.

We hope that those of our readers who incline to natural science will allow us to remind them that at no time before has the study of nature been considered so essential a part of life as at the present, whether undertaken as the pursuit of spare moments or as the serious profession of every day.

As regards our arrangements for 1903; in Astronomy Mr. A. Fowler will write a series of papers on Spectroscopic subjects, while Mr. Maunder, having now completed his articles on "Astronomy without a Telescope," will devote himself during the year to the discussion of subjects of current interest. Miss A. M. Clerke will deal with some "Theories of Gravitation," giving an account of the most recent speculations or discoveries regarding the mode of action by which the planetary and sidereal machines are kept going. Miss Clerke will also discuss some new views in Solar Physics. We hope to publish early in the year some photographs of Perrine's Comet, by Dr. Isaac Roberts, and articles on the Path of the Moon, by Mr. A. C. D. Crommelin, and on Stellar Satellites by Mr. J. E. Gore.

The column devoted to Comets and Meteors will be continued by Mr. W. F. Denning; while "The Face of the Sky" will still be in the hands of Mr. W. Shackleton, who proposes to aid the observer by additional diagrams.

Mr. R. Lloyd Praeger promises a set of articles on Familiar British Wild Flowers and their Allies. The extent, distribution, and character of various orders of plants will be dealt with, particular reference being made to the British species and the points of interest connected with them.

Mr. F. Enock regrets that he has been unable so far to keep his promise of contributing some life-histories of the insects, to the study of which he has devoted so many years, but he will redeem his promise during 1903.

Amongst other contributors we may mention that Mr. J. Collier proposes to write some papers on Sociology; Mr. Pycraft will supply some illustrated papers on "Wind Bags and their Uses in various Birds and Fishes"; Mr. D. Wilson-Barker hopes to tell us more about the Clouds, which he photographs so cleverly; and Mons. E. M. Antoniadi has prepared some very fully illustrated articles on S. Sophia, the structure and history of which he has studied very closely.

Mr. M. I. Cross will continue to conduct the Microscopical section, to which it is proposed to allot more space in order to provide for a programme which is fully set out under the Microscopical heading in this issue. In this connection Mr. Cross has already secured the assistance of such well-known workers as Messrs. Noad Clark, Earland, Rousselet, Sanger Shepherd, Soar, and Wesché.

A new Chess Solution Tourney for possession of the KNOWLEDGE Challenge Trophy will begin with the problems in the January number.

XUM

THE ERUPTIONS IN THE WEST INDIES.

Soon after the great eruptions in Martinique and St. Vincent last May, the Royal Society appointed a small commission to investigate the phenomena in both islands, and especially in St. Vincent. Dr. Tempest Anderson, a well-known student and photographer of volcanoes, and Dr. John S. Flett, of H.M. Geological Survey, left London on May 28th. They arrived at Barbadoes on June 8th, and proceeded to St. Vincent, where nearly four weeks were spent, chiefly at Chateaubelair and Georgetown, in the neighbourhood of the Soufrière. Early in July they visited Martinique for six days, in order to ascertain the general points of difference and similarity between the outbursts of Mont Pelée and the Soufrière, the phenomena in this island being studied by a French scientific commission under the directorship of Prof. Lacroix. On their return to England, a preliminary report was presented to the Royal Society, and was printed immediately in the *Proceedings*. As some time must elapse before the complete report is published, we give here a summary of this first paper, quoting fully from the interesting account of the eruption of Mont Pelée observed by the commission on July 9th.

THE ERUPTION OF THE SOUFRIÈRE.

The island of St. Vincent is oval in form, eighteen miles long from north to south, and eleven miles broad. The main axis is occupied by a mountain chain, composed entirely of volcanic materials. In the south of the island volcanic action has long been extinct or dormant, but at the north end stands the still active Soufrière. This mountain, which is 4048 feet in height, is a simple cone like Vesuvius, without lateral or parasitic craters. Its principal crater, known as the Old Crater, is nearly circular in form. Before the recent eruption, it was nine-tenths of a mile across, and about 1100 feet deep. The bottom was occupied by a lake, said to have been over 500 feet deep. On its north-east lip is a smaller crater, one-third of a mile in diameter, called the New Crater, as it is supposed to have originated in the eruption of 1812. The remains of a gigantic crater-ring surround the cone on its north side, bearing the same relation to it that Somma does to Vesuvius. Deep valleys have been cut in the slopes of the mountain, especially on its southern side; and it is in these that the greater part of the ejecta of the recent eruption have collected.

For more than a year before the eruption took place, the north part of the island was subject to frequent violent earthquakes; and, as far back as February, 1901, two settlements of the aboriginal Caribs were considering the advisability of deserting the district. About midday on Tuesday, May 6th, the first signs of the eruption were observed by residents on the south-west side of the mountain. At 2.40 p.m. there was a considerable explosion, and a large cloud of steam ascended into the air; at 5 p.m. a red glare was visible in the steam cloud on the summit; at midnight there was a great outburst, and red flames were noticed on the lip of the crater. Next morning gigantic mushroom-shaped clouds could be seen rising to a height of about 30,000 feet, and drifting away before the north-east trade wind. As the day advanced, the eruption increased in violence; by 10.30 a.m. enormous clouds of vapour were being emitted with loud noises, accompanied by much lightning; and it could be seen that the materials were mostly, if not entirely, discharged from the Old Crater. The activity now became continuous; huge columns of vapour ascended with frequent violent outbursts, projecting showers of stones and mud on all sides, and chiefly to the east. At midday on Wednesday, May 7th, the slopes of the mountain were still green, though a layer of fine ash, just sufficient to give the leaves a greyish colour, had fallen over the lower ground.

About this time, it was noticed that steam was rising from some of the valleys on the south side of the mountain. Soon afterwards, the Rivers Wallibu and Rabaca on this side were seen rushing down in raging floods of boiling water, and the whole mountain became enveloped

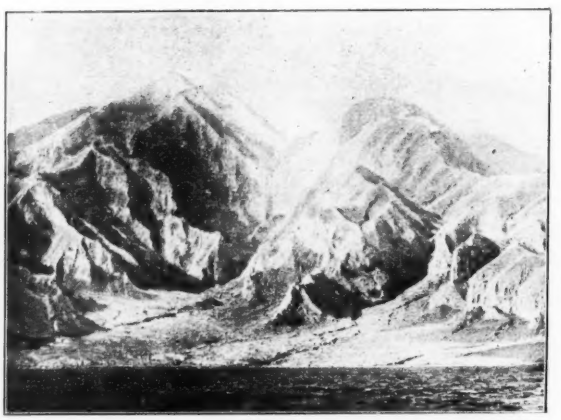

Fig. 1.—Mount Pelée from the West.

in a dense cloud of vapour. The crater lake seems to have been driven over the lower or south lip of the crater, and to have poured down the valleys as a tremendous rush of boiling water to the sea.

It is remarkable that, so far, the inhabitants on the east or windward side of the island had not realised their danger. As is frequently the case, the summit on this side was wrapped in cloud. Even on the morning of Wednesday, May 7th, sugar-making was in progress on several estates. By midday, however, all were convinced that the noises heard continuously were not due to a thunderstorm; but it was then too late to escape, for the Rabaca and other streams, usually dry except after rains, were running boiling hot and could not be crossed. It was here that the loss of life was greatest, the number of persons killed being estimated roughly at 2000, including about a dozen white men. On the opposite side of the island the loss was comparatively small. The view of the crater was clear, and the early outbursts of steam gave ample warning to the inhabitants, who fled along the coast to Chateaubelair and other places to the south.

To return to the eruption. At 1 p.m. the roaring of the volcano was tremendous, and after the large outbursts, which took place every few minutes, volumes of vapour might be seen covering the whole area. So far, there was nothing abnormal in the eruption, and the destruction was confined to the higher parts of the mountain.

But about 2 p.m. there was a rumbling and a large black outburst with showers of stones. A strange black cloud, laden with hot dust, swept down the mountain side burying the country in hot sand, suffocating and burning all living creatures in its path, and devouring the rich vegetation of the hill with one burning blast. On the west coast most of the inhabitants had escaped, but a few persons overtaken by the black cloud were killed or badly burned. One boat was near Richmond at the time the blast swept down. The heat is described as fearful. Hot sand rained into the boat, and the sea around was hissing with its

heat. The darkness was so intense that a man could not see his hand. On the east side of the island, a dense black cloud was seen rolling with terrific velocity down the mountain side towards the sea, flashing with lightning, especially when it touched the water. All survivors state that it was intensely hot, and was charged with hot dust, and that it smelt strongly of sulphur. They felt as if something was compressing their throats, and as if there was no air to breathe. The suffocating cloud only lasted a few minutes, and by the time it had reached the coast, the sand it contained, though still at a very high temperature, did not set fire to wood or burn the clothes of those exposed to it. At some distance from the cloud, one observer describes it as "a solid black wall of smoke falling into the sea about two or three miles from us. It looked like a promontory of solid land, but it rolled and tumbled and spread itself out until in a little time it extended quite eight miles over the sea to the west. . . . Then began the most gorgeous display of lightning one could conceive. . . . It was still bright daylight, but the whole atmosphere quivered and thundered with wavy lines intersecting one another like trellis-work. We were encircled in a ring of fiery bayonets."

Intense darkness now covered the whole north end of St. Vincent. The roaring of the mountain was terrible. Fine ash and sand rained down over the whole country, with occasional showers of large stones, some of which were so hot as to set fire to the "trash" roofs of huts seven miles from the crater. The eruption in all probability had reassumed the ordinary phase, the showers of ash and stones being produced by violent upward explosions of steam. Shortly before nightfall, the darkness lessened slightly, but the rain of dust and the noises lasted till early on the following morning (May 8th). When day broke, the volcano was still emitting puffs of slaty coloured steam, and showers of fine dust were falling on the west side of the mountain. A week later (May 15th) the volcanic activity had apparently subsided, and the mountain remained clear and unclouded until Sunday, May 18th, when a second but much slighter eruption took place. The noises were as loud as before, the lightning very vivid, and ashes and sand fell freely for some hours. Clouds of steam were sometimes seen gently rising for some days later, but no further outburst took place until after the publication of the preliminary report.

When the English commission arrived in St. Vincent on June 10th, the Soufrière and the surrounding country to the south of Chateaubelair and Georgetown were still covered with a layer of ashes, mostly in the form of a fine sand, mixed with spongy bombs and many ejected blocks composed of fragments of the old rocks of the hill. The latter consist of weathered andesites and andesitic tuffs, such as can be seen in the walls of the crater, some of them being more than five feet across. The larger bombs are often black, highly lustrous, and glassy when broken across. Some seen at Wallibu (four miles from the crater) were three feet in diameter. The sand when dry is yellowish-grey in colour, but when wet becomes almost black. It contains plagioclase felspar, hypersthene, augite, magnetite, and fragments of glass, and represents a fairly well crystallised hypersthene-andesite magma which has been blown to powder by the expansion of occluded steam.

Owing to the heavy tropical rains and the quick growth of vegetation, this deposit was rapidly disappearing. Around Georgetown it was from one to three feet deep, in the Carib country four feet, while on the higher slopes of the hill, where it had gathered in hollows, it reached a depth of from five to over twelve feet. Those who visited the country shortly after the first eruption described it as having a smooth, gently rolling surface like that of blown sand. It is clear that immense quantities of hot sand had rushed down the hill into the valleys in an avalanche which carried with it a terrific blast, and piled the ashes deep in the sheltered ravines, at the same time sweeping everything off the exposed ridges which lay between.

For some days after the eruption the stream valleys were level with their banks. But on May 24 and 25, nearly eight inches of rain fell, and with this the rainy season set in. After a heavy tropical shower, valleys that were usually dry were occupied by a thundering torrent several feet deep and twenty or thirty feet across, that soon swept away the ashes from the upper part of their channels. But in the lower valleys, which had been filled with thick masses of hot sand, the process of removal was still (in the middle of June) going on, and a curious spectacle was seen after every shower. The streams, by undermining their banks, caused land-slides, and when the hot ash fell into the water, columns of muddy water rose to about 200 feet, carrying with them pieces of stone, while immense clouds of steam shot up to heights of 700 or 800 feet, expanding in great globular masses, exactly like the steam explosions from a crater.

When Drs. Anderson and Flett ascended the Soufrière, there was the clearest evidence of the passage of a hot blast laden with sand. Near the shore on the east side, the sugar-cane fields were covered with three or four feet of sand and scoria; the trees were all bare, a few branches broken, but no trees were uprooted or thrown down. At

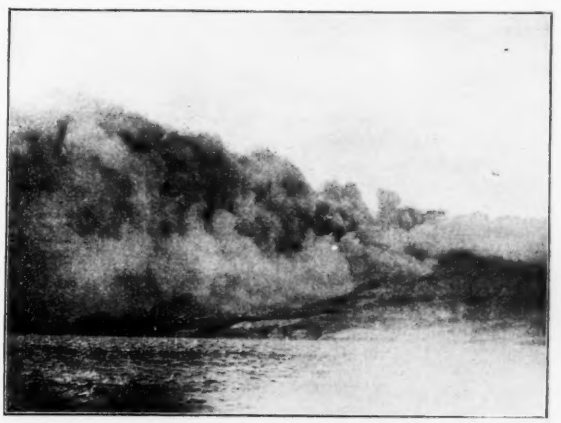

FIG. 2.—Mont Pelée in eruption on July 9th. (The lighter-coloured cloud on the right is the trade-wind cloud which so constantly covered the summit.)

this point the velocity of the blast was not above that of an ordinary gale, and the dust it carried, though hot, was not incandescent. At an elevation of about 1000 feet, a further stage of devastation was encountered; the fields were swept bare, the trees broken down though not as a rule uprooted, their smaller branches swept away; a deep layer of black sand covered the crops of sugar-cane. The blast was here a violent gale.

A little further up, enormous trees, even great cotton-trees ten feet or more in diameter, had been uprooted and cast down, the fallen trunks in every case pointing directly away from the crater. The smaller trees were sometimes swept away like straws. Most were charred, some deeply, but, as the wood was green, only the smaller branches had been consumed. The effect was like that produced by a violent hurricane, only more complete, for many of these trees had withstood the hurricane that ruined St. Vincent in 1898. Still higher, or above the 1500 feet level, there

was little left of the rich tropical vegetation which had covered the mountain. Blackened remains of tree-trunks were to be seen, overturned or broken off near the ground, and buried in dark sand. The highest parts of the mountain formed as bare and desolate a scene as could be imagined. The ash was five to twelve feet deep, and contained a good deal of burnt timber, utterly blackened and converted into charcoal. Everything was mown down, and there was nothing to show what was the velocity of the blast when it left the crater.

The structural modifications produced upon the mountain were very slight. No fissures were seen, no parasitic craters or cones were formed, and there were no lava streams. Even the craters at the summit retain essentially their old configuration, though the outline of the lip of the crater, as seen from Chateaubelair, has undergone some slight changes, and the southern edge is somewhat lower than it was before the eruption. The inner slopes of the crater, formerly richly wooded, are now naked slopes or precipices of rock. The depth of the crater was generally estimated at about 1600 feet. The bottom, when seen by the English commission, was nearly flat or slightly cup-shaped, and contained three small lakes of greenish and turbid water.

THE ERUPTION OF MONT PELÉE.

Mont Pelée, like the Soufrière, is a simple cone with a large vent near the summit and without parasitic craters. Both mountains are deeply scored with ravines, and on the south-west side of each there is a broad valley, occupied by St. Pierre in the one case, and by the valley of the Wallibu in the other. It is in these valleys that the destruction was most pronounced. In St. Vincent, however, the mass of material ejected and the area devastated were much greater than in Martinique. The loss of life was less, but this was due to the absence of a populous city at the foot of the Soufrière. On Mont Pelée the blast that overwhelmed St. Pierre was emitted from a triangular fissure, which opened on the south side of the mountain; on the Soufrière the blast came from the old orifices. The eruption in Martinique began with the flow of mud lavas, while none such were seen in St. Vincent. These are the chief points of difference between the two eruptions. On the other hand, both were characterised by a complete absence of lava streams and by the paroxysmal discharge of hot sand and dust mingled with a small proportion of bombs and ejected blocks. The hot blast which swept down on St. Pierre was similar to that emitted by the Soufrière.

During their brief sojourn at Martinique, Messrs. Anderson and Flett were fortunate in witnessing one of the more important eruptions of Mont Pelée, evidently a counterpart of that which destroyed St. Pierre. On July 9th, they were near St. Pierre in a small sloop that had been hired for their expeditions. During the morning the volcano was beautifully clear, and only occasional jets of steam rose from the triangular fissure that served as a crater. A little after midday, however, large steam clouds began to rise, one every ten or twenty minutes, with a low rumble. While they rose they expanded, and, as they consisted of many globular rolling masses, they bore some resemblance to a gigantic cauliflower. About half past six it was obvious that the activity of the mountain was increasing. The cauliflower clouds were no longer detached, but arose in such rapid succession that they were blended in a continuous emission. A thick cloud of steam streamed away before the wind, so laden with dust that all the leeward side of the hill and the sea for six miles from the shore were covered with a dense pall of fine falling ash.

"Just before darkness closed in, we noticed a cloud which had in it something peculiar hanging over the lip of the fissure. At first glance it resembled the globular cauliflower masses of steam. It was, however, darker in colour, and did not ascend in the air or float away, but retained its shape, and slowly got larger and larger. After observing it for a short time, we concluded that it was travelling straight down the hill towards us, expanding somewhat as it came, but not rising in the air, only rolling over the surface of the ground. . . . It seemed to take some time to reach the sea (several minutes at least), and as it rolled over the bay we could see that through it there played innumerable lightnings. . . . As the darkness deepened, a dull red reflection was seen in the trade-wind cloud which covered the mountain summit. This became brighter and brighter. . . . Suddenly the whole cloud was brightly illuminated. . . . In an incredibly short space of time a red-hot avalanche swept down to the sea. . . . It was dull red, with a billowy surface, reminding one of a snow avalanche. In it there were larger stones which stood out as streaks of bright red, tumbling down and emitting showers of sparks. In a few minutes it was over. . . . Undoubtedly the velocity was terrific. Had any buildings stood in its path they would have been utterly wiped out, and no living creature could have survived that blast.

"Hardly had its red light faded when a rounded black cloud began to shape itself against the star-lit sky, exactly where the avalanche had been. The pale moonlight shining on it showed us that it was globular, with a bulging surface, covered with rounded protuberant masses, which swelled and multiplied with a terrible energy. It rushed forward over the waters, directly towards us, boiling, and changing its form every instant. In its face there sparkled innumerable lightnings. . . . The cloud itself was black as night, dense and solid, and the flickering lightnings gave it an indescribably venomous appearance. It moved with great velocity, and as it approached it got larger and larger, but it retained its rounded form. It did not spread out laterally, neither did it rise into the air, but swept on over the sea in surging globular masses, coruscating with lightnings. When about a mile from us it was perceptibly slowing down. We then estimated that it was two miles broad, and about one mile high. It began to change its form; fresh protuberances ceased to shoot out or grew but slowly. They were less globular, and the face of the cloud more nearly resembled a black curtain draped in folds. At the same time it became paler and more grey in colour, and for a time the surface shimmered in the moonlight like a piece of silk. The particles of ash were now settling down, and the white steam, freed from entangled dust, was beginning to rise into the air.

"The cloud still travelled forward, but now was mostly steam, and rose from the surface of the sea, passing over our heads in a great tongue-shaped mass, which in a few minutes was directly above us. Then stones, some as large as a chestnut, began to fall on the boat. They were followed by small pellets, which rattled on the deck like a shower of peas. In a minute or two fine grey ash, moist and clinging together in small globules, poured down upon us. After that for some time there was a rain of dry grey ashes. But the cloud had lost most of its solid matter, and as it shot forward over our heads it left us in a stratum of clear pure air."

"The most peculiar feature of these eruptions," write Drs. Anderson and Flett in concluding their report, "is the avalanche of incandescent sand and the great black cloud which accompanies it. The preliminary stages of the eruption, which may occupy a few days or only a few hours, consist of outbursts of steam, fine dust, and stones, and

the discharge of the crater lakes as torrents of water or of mud. In them there is nothing unusual, but as soon as the throat of the crater is thoroughly cleared, and the climax of the eruption is reached, a mass of incandescent lava rises and wells over the lip of the crater in the form of an avalanche of red-hot dust. It is a lava blown to pieces by the expansion of the gases it contains. It rushes down the slopes of the hill, carrying with it a terrific blast, which mows down everything in its path. The mixture of dust and gas behaves in many ways like a fluid. The exact chemical composition of these gases remains unsettled. They apparently consist principally of steam and sulphurous acid. There are many reasons which render it unlikely that they contain much oxygen, and they do not support respiration." C. D.

THE DOMESTIC ECONOMY OF THE THRUSH.

As observed by A. H. MACHELL COX, M.A.

FROM an æsthetic point of view never did summer-house less justify its existence than the hideous rectangular erection which disfigured one of the most perfect gardens I have known. There was not the faintest pretence of rusticity about it. Painted a vivid green outside and in, it boasted a door at one end, and glass windows, incapable of being opened on each remaining side. It was a matter for congratulation that such an abominable structure should be partially concealed behind a screen of laurel, box, and holly, and especially so to my mind, because by this means it became converted into a unique post of observation for the prowling naturalist. I soon learnt to appreciate it as such, and one Easter, when I was more or less incapacitated from strenuous exertion by the effects of influenza, I availed myself to the full of the opportunities it offered.

A tour of inspection on April 11th had revealed the nests of two thrushes in the laurels on different sides of the summer-house. One of these was not conveniently placed for close observation, and I will dismiss it with only a word or two. It had been built in evident haste, and the inner lining of mud and decayed wood was so incomplete that the light showed through the whole of one side of the nest. Nevertheless it contained one egg, on which, as is frequently the case, the mother thrush was already sitting for a great part of the day. A second egg and a third were laid on succeeding days, and the clutch appeared to be complete, for these were sat on closely for three full days before a fourth egg made its appearance in the nest. Three of these eggs were eventually hatched on April 28th, and the last on April 29th.

A peculiarity of the second nest was that it had been built upon the remains of a bullfinch's nest of the previous year. There were four eggs which were hatched on April 14th. From that date onwards I spent many an hour in studying the principles of the domestic economy of these birds. It might be supposed by anyone who had not made the experiment that the familiar song-thrush would be a good subject for this purpose, but, as a matter of fact, it is most fidgetty and impatient under scrutiny.

"Being observed," wrote Mrs. Browning, "when observation is not sympathy, is just being tortured"; if this is true of mankind, it may be accepted as an axiom where birds are concerned, and for the most part even without the qualifying clause, for, through no fault of their own, they are slow to recognise sympathy. This, however, was an excellent opportunity for seeing without being seen. The nest was four feet from the ground, and about the same distance from the window; so nothing more was needed than to paste the latter up from inside, leaving a small spyhole. A chair was placed in position, with a small table beside it, on which were my watch and paper and pencil ready for use. By approaching cautiously from the opposite side I generally managed to slip in unobserved, and, once there, I could sit taking copious rough notes with the happy consciousness that, in spite of my startling proximity to the nest, I could breathe freely and make small movements with no fear of betraying my presence. I even removed some of the laurel leaves outside, so that nothing should impede my view.

After a little while I found to my satisfaction that I was able, as a rule, to distinguish the female from the male by the slightly different markings of the throat. The male seemed to do a good share of the work, and he found very little time for singing. Food was brought on an average once every five minutes throughout the day, and there was no perceptible increase in the number of visits as the young became bigger.

By very close watching I satisfied myself as to the impartial distribution of food, though at first sight it seemed to be left entirely to chance. As often as not, at a single visit one hungry mouth was fed, and one only, and not unfrequently this privileged nestling would receive the next supply too. But the pangs of hunger soon restored the balance; those in most immediate need struggled hardest to assert themselves and to gain the best position. All mouths would be opened to the widest extent on the next visit, and the parent without hesitation would deposit the food in that which was readiest to receive it. This primitive arrangement embodies a principle which alone makes it possible to provide for a ravenous brood with the necessary impartiality. Watch an old starling surrounded in the field by her inexperienced family, who press eagerly round her as she probes deep into the ground for a hidden grub; this obtained, she does not dispose of it at once, but dashes off at top speed followed by her youngsters; after running a score of yards she stops abruptly and gives the prize without more ado to the nearest pursuer. The hungriest will have exerted himself the most. It is the same principle, and a fair one on the whole, but what happens when one is more weakly than his fellows from the first?

I must now allude to the sanitary arrangements for keeping the nest clean and habitable. Here I confess my preconceived ideas received a shock, and I made, what was to me, quite a new discovery. For instead of the droppings being removed to a distance by the parents, the latter invariably swallowed them. At first I thought I must be mistaken, but I witnessed it again and again, and the mode of procedure was always the same. A mouth was filled, a parent remained waiting a moment or two on the edge of the nest, and then, after a slight change of position of the young bird, reached down to receive the excrement, which was deliberately eaten. Any delay brought an impatient peck as a reminder; only once did this fail to have the desired effect, and then the omission was rectified on the next visit. These methods were scrupulously adopted by both parents from the very first, and were only discontinued when the young birds left the nest. I may add that a year later I watched just the same proceeding at a mistle-thrush's nest, and I can well believe that the blackbird has a similar habit. Now, at the time I searched all the books available, but failed to find any mention at all of this remarkable fact. Quite recently, however, when looking through some back numbers of KNOWLEDGE, I came across a most interesting paragraph on the subject by Mr. H. F. Witherby.* His remarks were based on observations of a mistle-thrush's nest. From this paragraph I learnt that the habit of swallowing the droppings

* *See* KNOWLEDGE, 1898, p. 66.

had been described by Mr. Weir in Macgillivray's British Birds. Mr. Weir observed that in the blackbird, song-thrush and mistle-thrush the old birds swallowed nearly all the droppings of their brood. Moreover, he shot one of the birds and found the droppings in its stomach. Since Mr. Witherby's observations the habit has been recorded in these columns by the Rev. A. East* and by Mr. George J. Chapman.† I was particularly interested to find that Mr. Witherby suggested that the parent birds at the time when they are busily occupied with the needs of their hungry offspring, probably derive a considerable amount of their own nourishment in this curious manner. This is just the conclusion I arrived at independently, and I was strengthened in this belief when I observed that the thrushes allowed no time for their own feeding. A great many of the worms that they brought were found close at hand on the lawn in front of me, and from my window I could sometimes keep one bird under perpetual observation for half-an-hour at a time. As a matter of fact I often had my eye at the spy-hole even while I was writing a note for fear of missing something of interest.

So far from my occupation becoming monotonous, I only regretted that my health did not allow me to remain at my post for the entire day, from before dawn until after dusk; the question of meals would have presented little difficulty. As it was, I was continually witnessing pretty incidents which would have delighted the heart of a photographer. One of the most eventful half-hours which I spent thus was when the young birds were only two days old. I had got to my place of concealment unobserved soon after noon, when a slight shower came on. The female at once appeared with food, of which she hastily disposed, and then settled down on her brood. Five minutes later the male arrived on the scene with a large supply of worms, cut up in lengths ready for distribution. It was charming to see the perfect understanding between the two parents; the mother, without otherwise moving, threw back her head and received a share of the worms; she then took her stand on the opposite side of the nest, and the pair dipping down fed the hungry mouths stretched up between them; finally the cleansing process was carried out as I have described, and the female resumed her seat. Very soon her mate was back, but this time having a smaller supply he refused point blank to allow her a portion. She reached up and tried to snatch it out of his bill, but he only held it higher, so there was nothing for it but to stand aside, and allow the proud father to do the work which he so evidently enjoyed. On his next return, however, five minutes later, he made amends by giving his partner a whole worm for her own consumption. About this time the shower of rain became a regular downpour, and the careful mother stood up, and shaking herself, spread out her wings until they overlapped the edges of the nest, thus completely sheltering her chicks beneath. Her back was dripping but she seemed well content; in fact it was as good as the bath that thrushes always delight in, and she passed the time preening her feathers with great care. Once or twice, in the most natural manner possible, she obtained a drink by catching a raindrop that trickled off a broad leaf beside her. Meanwhile the male was not idle, for when the shower suddenly stopped, he reappeared at once with a good supply of food, and his partner was enabled to fly off and stretch her limbs.

Later in the day I waited a whole hour and a half without once seeing the young fed, and had a practical illustration of the thrush's nervous temperament. The fact was that I had been ill-advised enough to put down within ten yards of the nest some crumbs, which both parents inspected from time to time with every sign of uneasiness. At the end of a long hour the male indeed summoned up courage to bring a specially large worm, but having got as far as the nest there he stood leaning over it, perfectly motionless, in a listening attitude for a good five minutes, and then, quite regardless of the four gaping mouths which he had been tantalising, he deliberately settled himself down on the brood. There he remained equally motionless for the next half-hour, at the end of which I left him with a long worm still dangling from his bill. I saw just the same thing happen on another occasion.

I should mention that about this time a pair of robins were intent on building inside the summer-house. When the young thrushes were nearly fledged one of the robins paid them a visit. They heard him coming, mounting up from branch to branch by the route their parents were wont to take. I saw them stretch their necks as usual in eager anticipation. It was comical to witness their dismay at the unexpected apparition; they subsided deep into the nest, while their visitor surveyed them with lordly disdain and then passed on.

The time was drawing near for the final departure of the brood. I was most anxious not to miss this, and was fortunate in actually seeing the first chick leave the nest. On the thirteenth day of their existence I was on the scene early in the morning, and saw at once that they were getting very restless and anxious to explore the wide world. Had I walked openly to the nest, there is little doubt that they would have flown off one and all without hesitation, as I had caused another brood to do a few days before. In this case, however, I had the much greater satisfaction of watching them screw up their courage to take the fateful step of their own accord. One youngster was disposed to take the lead from the first. In the absence of his parents he wriggled himself up till he so stood on the edge of the nest; after some hesitation he began to walk gingerly round it; he had almost got back into his place, however, when a parent appeared, and the latter found nothing amiss. Hardly had she flown off, when the adventurer was on his feet again, and stepped boldly off on to a branch. Finding all well so far, he fluttered down to a lower one, and there he stuck. Then, for the first time, I heard the familiar chirp of a young thrush, and I am inclined to believe that they never utter it until they are at large. His example was soon followed by two of the others, and this was the scene which met the eyes of their mother on her next visit. She seemed decidedly disturbed by the turn things had taken, and as an object lesson bestowed all the food she had brought on the exemplary chick that had stayed at home. A few minutes later he too had fluttered out. This led up to one of the most delightful tableaux of the whole series. All four young birds were now scattered, but still quite close, and holding on for dear life. The mother bird, as a last resort, took her stand at the nest with a tempting worm in her bill; there she waited, looking from one to another as if to invite them to return, and every now and then, by way of making her meaning plainer, she bent down into the nest and went through all the actions of feeding an imaginary brood. Several of her family appeared to think twice about going back, but knew not how to manage the return journey, till at last in disgust she ostentatiously swallowed the tit-bit herself. Presently, however, compelled to realize that a new phase of their home life had been entered upon, she bravely settled down with her constant mate to do all that was needful for their welfare, apparently recognising in her maternal wisdom the added perils that would beset her offspring in the next stage of their development.

* KNOWLEDGE, 1899, p. 133. † KNOWLEDGE, 1899, p. 178.

TWO FASHIONABLE FURS.

By R. LYDEKKER.

To those who are of an observant nature, an afternoon's stroll through any of the fashionable London thoroughfares during last winter must have revealed the prevalence of a fashion for the beautiful furs respectively known as blue fox and white fox. The skins of these animals are either worn entire as boas (or "necklets" as, I am told, they are called by ladies) or made up as muffs, and in either condition are strikingly beautiful. Blue fox has long been highly esteemed as a fur, skins selling for between ten and fourteen guineas a dozen years ago. White fox, on the other hand, has only during the last year or two been appreciated as its beauty deserves, the price per skin having risen from between half-a-crown and sixteen shillings and sixpence in 1891, to three or four guineas, or even more, during last season.

But it is not the price of either the blue or the white skins that I propose to discuss in detail in the present communication. The circumstance to which I desire to draw the attention of my readers is the very remarkable one that both the blue and the white skins belong to one and the same kind of animal. At first sight this may seem, perhaps, a fact of no special interest or importance. For, as we all know, certain species of mammals, such as the stoat or ermine, the mountain hare, and the lemming, are normally white in certain parts of their habitats in winter and dark-coloured in summer. Again, many mammals vary to a great extent in coloration according to locality, so that there may be dark-coloured and light-coloured races inhabiting different localities. The most striking instance of this is, perhaps, the bighorn wild sheep of North America, which in the Rocky Mountains is a "khaki"-coloured animal with a white rump, but in Alaska is nearly pure white all over throughout the year. It is true, indeed, that American naturalists prefer to regard the bighorns of the Rocky Mountains and Alaska as distinct species rather than local races of a single variable animal, but for our present purpose such slight differences of opinion do not really affect the case one way or the other.

That white fox and blue fox are not (as was once supposed to be the case by some naturalists) the summer and winter coats of the same individual animals, will be apparent by a comparison of furs of the two descriptions worn by our lady friends. The two descriptions have the same long thick hair, with a woolly under-fur at the base, and both are evidently the winter coats of the animals to which they respectively belong. Indeed, with all long-haired animals of the northern parts of the Old World, with the possible exception of the polar bear, it is the winter coat that is alone valued by the furrier.

That blue and white foxes are not local races of the same species (or distinct species) is evident from the fact that in certain districts both occur together, although in other localities (as in Iceland, where all the foxes are blue) only one form may be met with. It may indeed be possible that in some cases blue and white cubs may occur in the same litter. For instance, Professor A. S. Packard, in his work entitled "The Labrador Coast," states he was informed by a native "that the white and blue fox littered together, but that the blue variety was very rare." More precise information is required on the subject of their interbreeding, but it is quite certain that the blue fox and white fox of the furrier are only individual phases of the winter coat of a single species.

Although it is stated that white specimens are occasionally met with in summer, the white phase of the Arctic fox (as the species is called) normally assumes a dark coat in summer. The difference between the winter and summer coats of this phase of the species is well illustrated by a couple of specimens which have recently been placed in the central hall of the Natural History Museum, in Cromwell Road. In the case containing the mountain hare, ptarmigan, stoat, and weasel in their white winter dress has been introduced a specimen of the Arctic fox in the same coat. To contrast with this, the case in which are placed the above-mentioned animals in their dark summer costume now contains a specimen of the white phase of the Arctic fox in its dark summer livery. In this specimen, the hair (which is much shorter than that of the example in the winter dress) is dirty rufous brown shading into grey on the upper-parts and outer sides of the limbs, and yellowish white below. In other examples the colour of the upper-parts is greyer, while the under-parts are nearly pure white. Sometimes also, it is stated, that grey hairs are largely mingled with the white winter coat, so that we have a more or less marked tendency towards the blue phase even in the winter dress. In all cases the muzzle remains black, and it is stated that there may occasionally be a black tail-tip in the white winter dress. I have not seen a "blue fox" in the summer dress, but am told that the coat is then chiefly distinguished from its winter condition by its much shorter hairs and less pure blue colour.

Of course the so-called "blue" of even the best skins is a slaty or French grey rather than a blue in the proper sense of the word, and in many instances it tends to drab or dark purplish. Alaskan blue fox, which is somewhat coarse in the texture of the fur, has this purplish or sooty tinge most strongly developed, and at one time was specially valued on this account, although during the past season the lighter varieties seem to have been chiefly in demand.

Lest any of my readers should be led to think that the Arctic fox is a near relative of the common species, it may be well to state, before going any further, that it is a very distinct animal indeed. Apart from its coloration, the most distinctive features of the species are to be found in its short rounded ears (which look almost as though they had been cropped), moderately sharp muzzle, very long and bushy tail, and the coat of hair on the soles of the feet. From this latter feature the species takes its name of *Canis* (or *Vulpes*) *lagopus*; the object of the hairy soles being, of course, to afford the animal a firm foothold on the ice and frozen snow on which it passes so much of its time. In having two distinct colour-phases at all seasons of the year, which may be met with in the same locality, the Arctic fox stands practically unique among mammals. It is true that, according to Mr. F. C. Selous, black-maned and yellow-maned lions occasionally occur in the same litter, while black leopards and black jaguars are found now and then among litters of cubs of the ordinary colour. But neither of these instances are exactly on all fours with the case of the Arctic fox With regard to the lion, it has now been ascertained that the black-maned and tawny-maned specimens belong, in most cases at any rate, to distinct local races; and, as Mr. Walter Rothschild has recently pointed out, it is most probable that when light and dark-maned cubs are met with in the same litter it is due to crossing between two of these races. Black or melanistic leopards and jaguars, on the other hand, are more analagous to albinoes, and generally occur in hot and damp climates. The black phase of the common water-vole, found high up in many British valleys, is an instance somewhat analogous to that of black leopards, being apparently due to climatic conditions, and therefore not strictly comparable with the case of the Arctic fox.

Many invertebrate animals exhibit two or more distinct phases,—generally differing to a certain extent from each

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other in details of form or structure—and to such the name of dimorphic species is technically applied. Naturalists have agreed to designate the Arctic fox by the same title, although, were it not that it might be taken to convey an altogether different meaning, the term dichroic would be more appropriate, seeing that the difference between the two phases is solely one of colour, and has nothing to do with shape or structure. Using, then, the term dimorphism as indicative of the existence in one animal of two distinct colour-phases totally unconnected with either locality or season, the Arctic fox appears to be the only mammal to which the designation can be properly applied.

The reason for this remarkable dimorphism in the Arctic fox is hard indeed to discover, and no satisfactory explanation of the puzzle appears hitherto to have been offered. It is almost unnecessary to say that the reason why Arctic and sub-Arctic animals turn white in winter is that they may be as inconspicuous as possible in their environment of snow and ice. And if blue foxes were met with only in countries where snow lies but a short time in winter, while white ones occurred solely in more northern lands, some clue to the puzzle might be forthcoming. But as a matter of fact this is not the case.

The distribution of the Arctic fox is circumpolar, extending in the New World about as far south as latitude 50°, that is to say, nearly to the southern extremity of Hudson Bay, and in the Old World to latitude 60°, or, approximately, to the latitude of Christiania and the Shetland Isles. Northwards the species extends at least as far as Grinnel-land.

In Iceland all the Arctic foxes appear to belong to the blue phase, and as that island is far to the south of many portions of the habitat of the species, it might be thought that this is the reason why the white phase is unrepresented there. But that island is far north of the line where the mountain hare and the stoat begin to assume a white winter livery; and if it is essential for these species that they should assimilate their colour to that of their surroundings, why is it not equally so in the case of the Arctic fox?

Again, although, as already mentioned, blue foxes are rare in Labrador, in Alaska they are comparatively common, and the same is the case in Greenland, whence, according to Mr. W. Poland, the Royal Greenland Company imported 1,451 to Copenhagen in 1891. And if it be essential for animals to turn white in winter in any country in the world, it is surely Alaska. It is difficult to ascertain the proportion of blue to white foxes in either Alaska or the Pribiloff Islands, but it is certain that in both localities the two phases are found together, living apparently under precisely the same physical conditions.

As regards the islands last named, Mr. Elliot, in his work on the "Seal Islands of Alaska," writes that—"Blue and white foxes are found on the Pribiloff Islands, and find among the countless chinks and crevices in the basaltic formation comfortable holes and caverns for their accommodation and retreat, feeding upon sick and pup seals, as well as water-fowl and eggs, during the summer and autumn, and living through the winter on dead seals left on the rookeries, and the carcases on the killing-grounds."

This account, then, fully establishes the fact that blue and white foxes occur in regions where, according to all accepted rules, there ought to be none but white individuals, during the long and dreary winter. It gives, however, no definite clue to the reason for the strange association.

There is, however, a description of the habits of Arctic foxes in Grinnel-land given by Colonel Fielden in his "Voyage to the Polar Sea," which may possibly throw some light on the subject, although unfortunately it does not tell us whether blue as well as white foxes are found in that region. After referring to the numbers of lemmings to be seen looking out from the mouths of their holes, or feeding in the vicinity, the author proceeds as follows:—

"We noticed that numerous dead lemmings were scattered around. In every case they had been killed in the same manner; the sharp canine teeth of the foxes had penetrated their brain. Presently we came upon two ermines killed in the same manner. . . . . Then, to our surprise, we discovered numerous deposits of dead lemmings; in one hidden nook under a rock we pulled out a heap of over fifty. We disturbed numerous 'caches' of twenty and thirty, and the earth was honey-combed with holes, each of which contained several bodies of these little animals, a small quantity of earth being placed over them. In one hole we found the greater part of a hare hidden away. The wings of young brent-geese were also lying about; and as these birds were at this time just hatching, it showed that they must be the results of successful forays of prior seasons, and that consequently the foxes occupy the same abodes from year to year. I had long wondered how the Arctic fox exists in winter."

Now it will be evident that in this instance the foxes killed the prey stored up for winter use while they were in the dark summer coat. And since in winter, when the birds have left and the lemmings have retired to the depths of their burrows, they have no game to capture and no enemies to fear save polar bears (which would not be likely to do them much harm), it would appear to be a matter of no consequence whether their coats be dark or light. Consequently, it seems a possible explanation of the phenomenon under consideration that the blue phase of the Arctic fox indicates a reversion to the ancestral coloration of the species, due to the fact that no advantage is to be gained by the assumption of a white livery. Such reversion might well take place only in certain individuals of a species, and would probably tend to become more or less completely hereditary. Before such an explanation can, however, be even tentatively accepted, it is necessary to ascertain whether the blue Arctic foxes of Iceland are in the habit of making winter stores of provisions. If they are not, but hunt their prey in winter, the theory will not hold good.

As regards animals which hunt their prey in winter, or are themselves hunted, it would seem essential that they should be white even in the highest latitudes, where the long polar night lasts half the year. For in the bright starlight—to say nothing of moonlight—they would, if dark-coloured, be almost as conspicuous on the snow as in daylight.

As regards the number of Arctic fox-skins which find their way into the market, Mr. Poland, writing ten years ago, states that from 25,000 to 60,000 of the white phase were then annually imported from Siberia, the greater number coming to Leipsic. The fur of these is of a rather coarse quality, quite different to that of the fine-haired Greenland skins. In 1891 about 9000 white skins were imported by the Hudson Bay and Alaska Companies, and nearly 1000 by the Royal Greenland Company. Of blue skins about 2000 were annually imported into London by the Alaska Company, and some 500 to Copenhagen by the Greenland Company, although in 1891 the number of skins sold by the latter body reached 1451. It is noteworthy that in the fur-trade Greenland blue fox skins are noted as being of the same fine-haired quality as the white skins from the same locality, while the Alaskan blue skins are equally coarse-haired, consequently there is presumptive evidence of the existence of a Greenland and an Alaskan local race of the species.

THE COMETS OF 1903.

By J. B. DALE, M.A.

IN the year 1903 the returns of eight periodical comets are due. It is very improbable, however, that more than two or three out of their number will be seen. Some of them will remain invisible on account of their unfavourable situation with respect to the earth at the time of passing their perihelia; and in the case of two at least, planetary perturbations will have disturbed the orbits to such a degree that the dates of their reappearances must be regarded as very uncertain.

The following list is based upon the elements obtained from the positions observed at last apparition:—

Comet.	Periodic Time in Years.	Approximate Dates of Last Aphelion Passage.	Approximate Dates of Next Perihelion Passage.	Number of times previously observed.
(1) Tempel-Swift	5·534	3 Mar., 1900	9 Dec., 1902	4
(2) Perrine ...	6·441	10 Feb., 1900	5 May, 1903	1
(3) Giacobini ...	6·549	3 Feb., 1900	15 May, 1903	1
(4) Spitaler ...	6·402	3 June, 1900	16 Aug., 1903	1
(5) Faye	7·566	1 Jan., 1900	13 Oct., 1903	8
(6) Winnecke ...	5·832	18 Feb., 1901	30 Dec., 1903	7
(7) Brooks ...	7·097	25 May, 1900	12 Dec., 1903	2
(8) D'Arrest ...	6·675	24 Sept., 1900	25 Jan., 1904	6

The first-named comet was discovered in 1869, and has been observed since at intervals of eleven years. During last aphelion passage it was in the neighbourhood of Jupiter, and in consequence of the attraction of this planet its return to perihelion will be somewhat later than stated in the table.

The comets bearing the names of Perrine and Giacobini were both discovered in 1896; Spitaler's was discovered six years earlier, and has already made one unobserved return. On the present occasion its distance from the earth will never be much less than twice the radius of the earth's orbit, so that very likely it will again escape detection. Apparent proximity to the sun will obscure Perrine's comet, but Giacobini's will be more favourably situated, and possibly may be seen after passing perihelion.

Three of the comets expected may be considered to be well-established members of the solar system. Faye's was discovered in 1843; in 1819 Pons discovered the comet that now bears the name of Winnecke, while D'Arrest's was discovered in 1851.

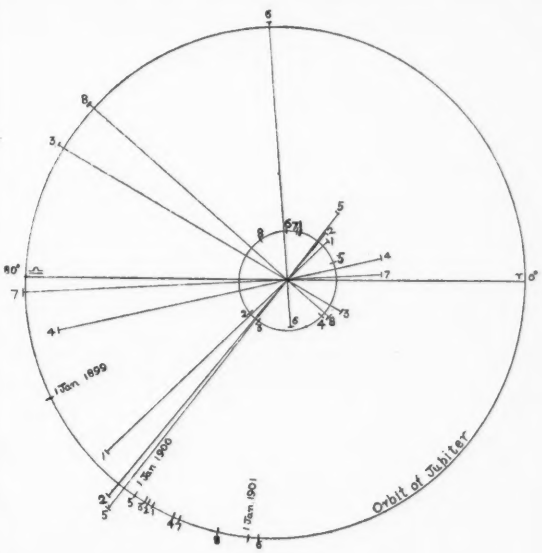
Unfortunately there is much cause for fear that the good character for regularity in its reappearances hitherto borne by Faye's comet will be found to have been lost since its last return. Its orbit lies close to that of Perrine's, and at the beginning of 1900 both comets were at their aphelia and near to Jupiter. Both bodies must have experienced considerable perturbations, but exact computations will alone show whether, in their new orbits, the comets will come within range of observation.

Neither Winnecke's nor D'Arrest's comets have suffered much perturbation, but, like Perrine's, they will at perihelion be on the opposite side of the sun to that on which the earth will be.

The remaining comet on the list, Brooks', is by no means so favourably situated as it was in 1889 and 1896; still its detection should not be regarded as hopeless. At the same time we must bear in mind that it has already shown signs of disintegration, and as yet we are so ignorant of all the conditions which determine the visibility of comets that it is presumption to speak with certainty regarding any of them.

All the above comets are members of a family closely connected with Jupiter. On the accompanying diagram are shown the major axes of the cometary orbits projected on the plane of the ecliptic, also the orbits of Jupiter and of the earth. The numbers placed at the extremities of the axes indicate the corresponding comets in the table, the numbered points on the orbit of Jupiter mark the positions of that planet at the aphelia of the comets, and the similarly numbered points on the earth's orbit its positions at the approaching perihelion passages.

It is noticeable that the aphelia points all lie close to the path of Jupiter. In addition to this, the inclinations of the planes of the cometary orbits to that of Jupiter are small, none exceeding 18°, while in every case the direction of revolution is the same as that of the general planetary motions. These facts indicate that whatever may have been the previous history of the comets, their present position in the system has been chiefly determined by the action of Jupiter, secondary of course to that of the sun.



This group of comets is of special importance in view of their comparatively short periodical times. They come frequently under observation, and every return adds to the material for writing their life-history.

In the triple system presented by any one of them in conjunction with Jupiter and the sun, we have one of the simplest cases of the problem of three bodies, a case upon which Hill, Poincaré, and Darwin have bestowed much labour, but whose complete solution is yet to be sought, if indeed it is attainable.

Perhaps the most striking circumstance which the study of these bodies has brought more prominently into notice, is that bodies moving under their mutual gravitation do not always tend towards aggregation and mutual coherence, but that disintegration is a frequent result. Jupiter not only captures comets, but also releases them, causing them to move in paths which may take them far beyond the limits of the solar system. Moreover, the condensation of a swarm of meteorites into a planet has yet to be explained, while it is not difficult to prove that the action of the sun, or of one of the larger planets, must under certain conditions bring about the disintegration of bodies passing near to them. Biela's comet is the classical example of such breaking up of cometary masses; but similar phenomena have been observed in comets Tempel-Swift and Brooks. For this reason their return may be looked forward to with interest.

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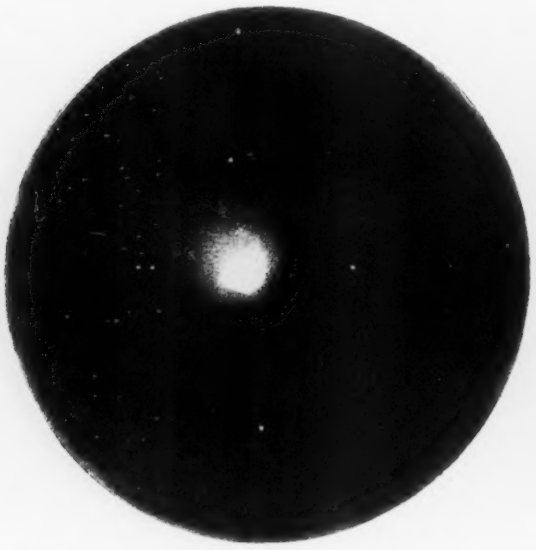
"COMET PERRINE."

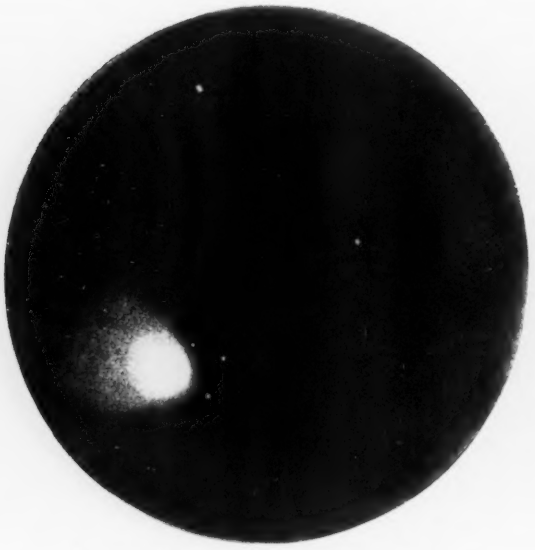
By MISS CATHARINE O. STEVENS.

MOONLIGHT has interfered very much with observations of the comet, but the exceptional series of cloudless nights during the latter part of September afforded opportunity for making the accompanying sketches, which are an attempt to convey some idea of its really exquisite beauty. The airy texture, the brilliance that is so delicately graduated from the glory of an arc light to a veil that scarcely dims the light of even a telescopic star, and that eludes even the skill of the photographer, furnishes an apology for the alternative of a portrait made by hand.



Comet Perrine.—11 p.m., 14 September, 1902.
[3 inch O.G., power 30.]

Comet Perrine.—9.30 p.m., 16 September, 1902.
[3 inch O.G., power 30.]



Comet Perrine.—8.37 p.m., 25 September, 1902.
[3 inch O.G., power 30.]

Comet Perrine.—Upon the background of the Milky Way.
12.5 p.m., 28 September, 1902.
[3 inch O.G., power 70.]

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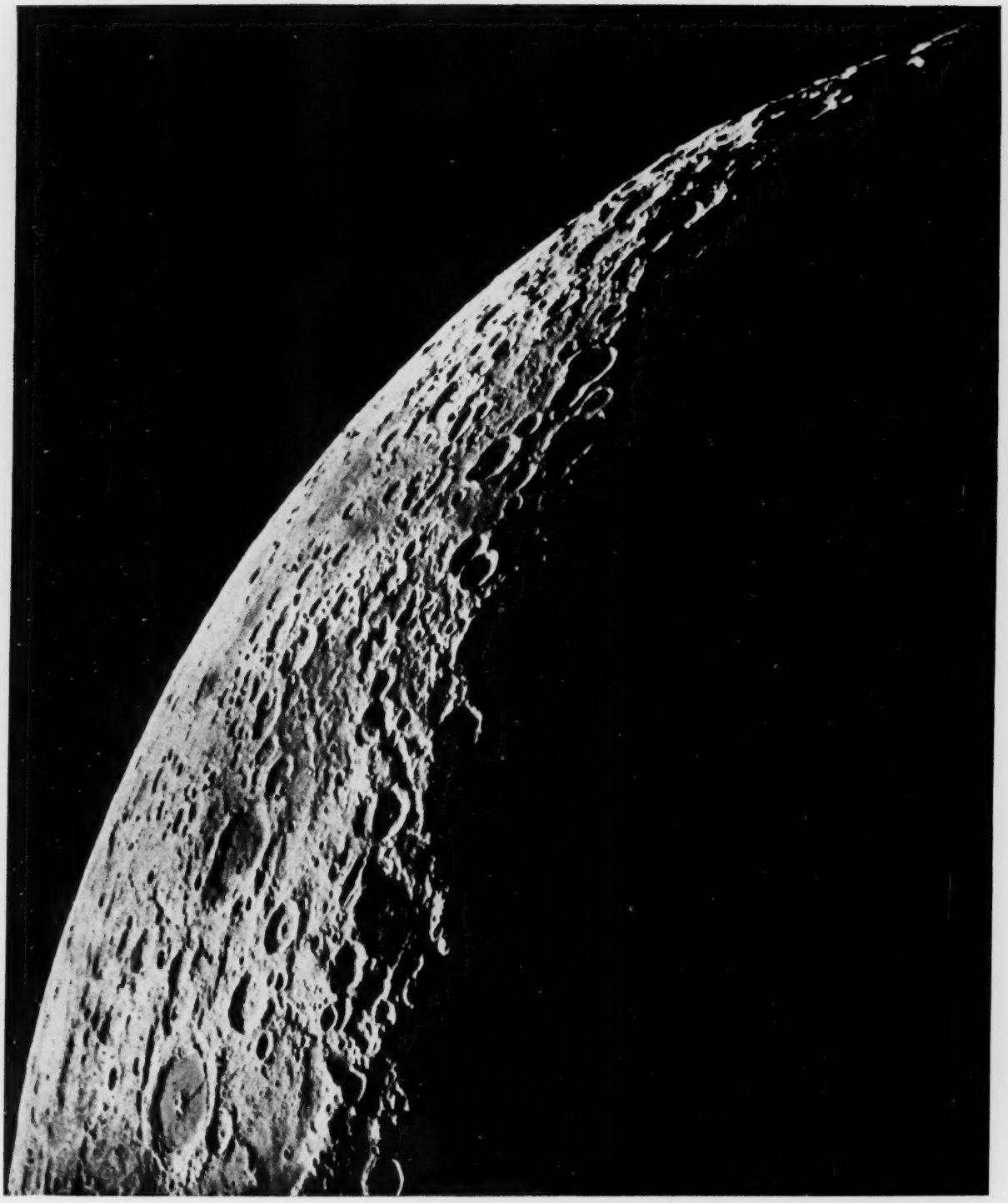
SOUTH.



WEST.

EAST.

NORTH.

THE SOUTHERN HORN OF THE CRESCENT MOON.

From a Photograph taken 1897, March 7th, 6·5h, Paris Mean Time, with the Great Equatorial Coudé of the Paris Observatory.
Scale: Diameter of Moon, 20¼ inches; Moon's Age, 4d. 6·4h.

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THE MOON'S SOUTHERN HORN.

By E. WALTER MAUNDER, F.R.A.S.

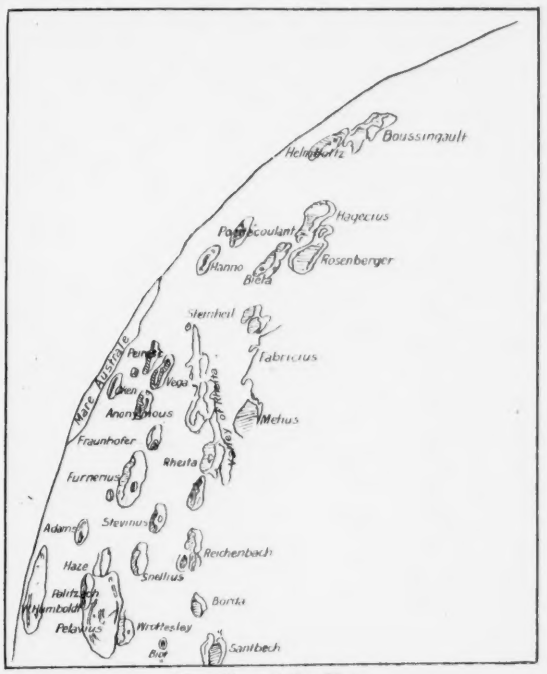
THE region of the moon shown in the present plate is taken from the fourth number of the "Atlas Photographique de la Lune," published by the Paris Observatory, and forms a continuation of the equatorial region of the moon described in KNOWLEDGE for March, 1901, under the title "Sunrise on the Sea of Plenty."

Under the grazing illumination of the sun's rays, it is seen that the moon's southern horn, like the major part of the moon's southern hemisphere, is riddled with craters. Here are a multitude of ringed and walled plains, craters and craterlets, clefts and ridges, lying, some in disorder, and some in an order so pronounced that it can scarcely be accidental. As it was pointed out in the earlier article, the meridian of 60° has upon it a series of great walled plains, Boussingault f, Pontécoulant G, Fraunhofer, Furnerius, Petavius, and beyond the southern horn the sequence is carried on by Vendelinus, Langrenus, Webb, Apollonius, Messala, and Schumacher, not to speak of the Mare Crisium, which the meridian bisects. This longitudinal arrangement of the great plains, taken in connection with the meridional ridges on the Mare Crisium, seems to indicate that the cause is to be found in the tidal attraction of the earth on the once plastic crust of the moon, which was then perhaps also exhibiting great volcanic activity.

Lying obliquely across the same meridian is another series of formations, scarcely less remarkable. These are four annuli composed of ring-plains and craters grouped together like beads on a necklace. The diameters of the annuli diminish in size, and their components also decrease as they approach the south pole. The largest and most northern annulus lies immediately to the south of Furnerius, and has for its southern edge the great Valley of Rheita and the ring-plains which it seems to have broken down in crossing. On its western border lie Fraunhofer and Vega and several other ring formations almost as large and important as these. The south edge is closed by several of the formations in the Vega region, but the northern edge lies open, save for the small crater Rheita B, between which and Fraunhofer lies a ridge of high ground which crosses the floor of the annulus, bending to the west and traversing Vega. The southern edge of this great annulus breaks into the northern edge of the next, whose southern apex is Hanno A, and, as a rule, the component ring-plains of the second annulus are much smaller than those of the first. The two more southerly annuli are formed of smaller craters still, and their areas are much more circumscribed. Pontécoulant joins the southern border of one to the northern border of the other, and obliterates them in these regions.

Three great valleys are seen stretching from the terminator across the illuminated horn, half way to the moon's limb, looking in the picture as if a hen had drawn her triple claw across the rugged surface. The two narrower shallower ones appear to spring from Fabricius, and skirt, one to the west of twin plains Steinheil A and B, and the other, farther to the west, to the borders of the second annulus. The third and most northerly, is the colossal Valley of Rheita, which, dwarfed by perspective, is yet nearly two hundred miles in length. It is less regular than the valley of the Alps, but it surpasses it visually in importance. In April, 1901, when discussing the ridges that cross the floors of the Maria Serenitatis and Imbrium, we pointed out that where these ridges left the sea bed and traversed the mountain ranges, there they seemed to be transformed into valleys; a notable instance being the prolongation of the great valley of the Alps into the Mare Frigoris, as a ridge to Egede A. In the case of the Rheita Valley and its companions, the only sea bed which is visible on this plate, the Mare Australe, is too narrow and foreshortened for it to be ascertained that the same coincidence of ridge and valley takes place here, but there are faint indications which seem to render it probable, and which might become more evident under a slightly different angle of illumination.

But as the sun rises higher on the moon's western limb, all this complexity of detail seems to be blotted out as by



Key Map of the Plate.

a wet sponge, and the region has become blank, or presents features that are unrecognisable when the sun's light slants on it as on March 7th, 1897. When the moon appears to us about half full, then Boussingault, Pontécoulant, Steinheil, and all the lesser ring-plains disappear; the Mare Australe shows up more plainly as a thin streak; the ring of Petavius is gone, and only the centre crater is to be made out; and the two secondary plains, Petavius B and Furnerius A, become the centres of brilliant "aureoles" and the focus of bright rays, such as those which emanate from Tycho.

But there is one feature which is no less evident when the moon is at the full than when it shows but a narrow horn of light; this is the especial brightness of the illuminated limb of the moon. On our plate it is visible as a narrow, almost even cornice of light all along the rounded edge. It is practically independent of the latitude on the moon, or of its age.

What is the cause of this? There is, of course, on the moon no atmosphere or dust-veil like that which renders the limb of the sun so notably less brilliant than the centre of the disk. But since the amount of light reflected by the moon in any given direction should decrease with increase of the angle made with the normal, we should expect that—as we see to be the case with Jupiter and Saturn—the limb should be inferior to the centre in brightness. There seems but one explanation of the

different state of things which we observe, viz., that the regions near the limb, as we see them, have a much higher reflective capacity than those near the centre. Nor is it difficult to see that this is actually the case. In the centre of the disk we see spread out before us the great grey plains, the floors of the craters and ring-plains, the bottoms of the valleys. And we note that these low-lying regions are far darker than the mountain tops; in other words, the lowest regions are the darkest; the most elevated are the brightest. But as we approach the limb the effect of the foreshortened presentation is to hide the valleys and crater-floors more and more from view, whilst the mountain sides are more fully presented to us. The brightness of the lunar limb is therefore due to the fact that it is here that the highlands are best seen, and the lowlands least. On the planet Mars, which also shows a bright limb, the similar effect may be due to the presence of clouds, too thin to be seen when looked down upon from above—and probably also much rarer under the midday sun than at morning or evening—but becoming quite evident when crowded together near the limb by the effect of foreshortening. Just as to a spectator on the earth, the horizon seems much more frequently and more densely clouded than the zenith.

The interest attaching to the brightness of the lunar highlands depends upon the cause to which it is assigned. It is probable that the actual material of the grey plains and crater-floors is in itself darker than that of the mountain crests and ridges. But there must be an action continually going on—slight and slow, but cumulative—tending to *clean* the upper slopes, and to transfer material down to the lower districts; a kind of weathering. The meteor rain, which the moon experiences in its proportion equally with the earth, must tend to rake the surfaces of the steep ridges, and to drive the matter it disturbs downwards. So, too, the alternate expansion and contraction of free particles lying on the slopes, as the lunar day and night succeed each other, will mean the gradual "creeping" downwards. Thus, however "dead" the moon may be, there must be even now a steady kind of denudation at work, a continual deposit of material in the lowlands from the surface-matter of the mountain slopes.

The interesting point is that this deposited material seems darker than that uncovered by its removal, as if on the moon, as on the earth, some process of tarnishing or oxidation were at work; as if the lunar atmosphere, rare as it must be beyond all terrestrial experience, is not wholly inefficient in this direction.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

A NEBULOUS STAR IN SCUTUM SOBIESKI.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Prof. Barnard informs me that the star in Scutum Sobieski, S.D.—10°, 4713,* referred to in my article on "Nebulous Stars and their Spectra," in your October number, is undoubtedly and conspicuously nebulous. He has not only photographed the dense glow encircling it more than a dozen times with varied exposures, but observed it visually as well. Moreover, Prof. Frost has kindly examined a spectrograph of the star taken by Mr. Ellerman with the Yerkes refractor in the autumn of 1899, and finds it to be of the most authentic helium type. Besides hydrogen and helium absorption, Scheiner's "high-temperature" magnesium-line at λ 4481 was recorded between Hβ and Hγ. No bright lines could be detected. The object, accordingly, conforms to precedent, and ratifies the association of a helium spectrum with an inchoate condition. The experiment would be worth trying of taking a spectrograph on a plate sufficiently sensitive in the green to test the emission of the chief nebular ray by the halo attached to this interesting star.

AGNES M. CLERKE.

London, October 23rd, 1902.

* Through an oversight, the erroneous designation B.D. 10° 4313 got printed in my article. The star's place for 1900 is R.A. 18h. 25·9m., Dec. —10° 52′.

THE CANALS OF MARS.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—On seeing that Mr. Maunder had reached slightly different results with regard to the exact nature of the delusion to which these appearances were due, I was at first rather at a loss to account for the fact, since the subjects of my experiments had all seen the canals on perfectly unstippled surfaces. Lately, however, the idea occurred to me that perhaps Mr. Maunder had made his drawings more hard and definite in outline than I had, and I therefore wrote to Mr. Maunder suggesting this explanation, and shortly after received a letter from him stating that in his drawings he had shaded in the "seas" with Indian ink, and had used smooth white Bristol board on which to draw them, whereas I had drawn mine in black lead, on rough, slightly yellowish drawing paper. The difference in character between these two kinds of drawing seems to me to explain adequately the slight disparity in our conclusions.

It will be understood, of course, that if a drawing is stippled over with minute dots, which are individually indistinguishable, the net effect is not that of a speckled surface, but merely that of a general and even darkening of the space so stippled. This darkening has the same effect as the lightening of the dark areas would have, *i.e.*, it makes the drawing more difficult to see, and the eye having thus less to definitely lay hold of, has more free play, and is more easily deceived into representing shadowy lines.

The probability of the truth of this explanation becomes greater, of course, when it is considered that even my comparatively feeble drawings had to be placed in the shadow before canals could be easily seen.

Thus the inability of the subjects of Mr. Maunder's experiments to see canals on unstippled surfaces does not point, as might at first sight appear, to the hypothesis that the red areas of Mars are speckled over with oases, but merely to the fact that the light areas are not so much brighter than the dark areas as they were represented on Mr. Maunder's drawings, and to a smaller extent on my own.

As everyone knows, the markings on the planet itself are anything but strongly marked. Of course this darkening of the red areas may be caused by oases, but of this we have no proof, and it seems simplest to suppose, for the time being, that except for the large spots whose existence no one can doubt, there are on the Martian continents no markings visible to our present telescopes, and certainly no canals; at least in our present astronomical conception of the meaning of the term.

B. W. LANE.

VISIBILITY OF THE CRESCENT OF VENUS.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—In July last a letter from Dr. Ryle appeared in KNOWLEDGE, from which, and Mr. Maunder's note, it would appear that the seeing the crescent with the naked eye is almost, if not altogether impossible. Permit me therefore to relate the following:—In either October or November, 1901, I was viewing Venus, and looking for Mercury one evening. Finding the latter I called two of my men, who were working near by, to come and look at what they had probably never seen before. When I pointed the direction of Mercury, one of them at once made it out with the naked eye. I then showed it to him with the telescope—a 3-inch refractor. Venus at the time was very bright, and to test his sight I asked him "What shape she was"? His reply at once was "Just like the new moon," and added, to my astonishment, "Is that the rest of the star, the dark round we see"? I then let him look through the glass, and he said "Yes, just the same, only much clearer." I cannot say as to astigmatism of his eye, as I do not know anything about it; but I feel sure that there was no imagination at work. He did not even know the planet's name, and all he did, when I pointed Venus out, was to shade his eyes with his hand, and answer at once.

A. W. MANSERGH, Lt.-Col.

Martness House, Portadown,
1st November, 1902.

SYNCHRONISM OF SOLAR STORMS AND TERRESTRIAL MAGNETIC DISTURBANCES.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—From the report of the July meeting of the B. A. A., I gather that the above subject has been once again under discussion. The Rev. Walter Sidgreaves' essay on the "Connexion between Solar Spots and Earth-Magnetic Storms" (*R. A. S. Mem.*, Vol. LIV.) is about the only purely scientific pronunciamento which I have had the pleasure to read on this controversy. Both sides, however, to my thinking, commit the error of allowing their respective views to be too much influenced by basing them exclusively on the speculative relations between earth-magnetic storms and "*sun-spots*," as if these latter were the one and only solar storm phenomenon subject to periodic cycles. I liken a sun-spot to the black storm-cloud we see here on the earth, the cloud being, however, merely *the scenery* of the storm proper, in which lightning and thunder alternate, from which rain or hail may fall, and underneath which a tornado may do havoc. But if these real storm-ingredients are absent, the mere passage of a cloud across the same landscape would be of little consequence. Similarly, then, a solar spot taken as a dark mark on the sun's surface denotes simply an interruption in the luminous photospheric clouds. Such a spot is not necessarily the one absolute requirement to produce a terrestrial magnetic storm, and in this sense it would, indeed, seem advisable to drop the idea of an *absolute connexion* between the two phenomena.

There are quite a number of solar periodic phenomena, partly well known and partly justifiably surmised, which accompany the spot cycle, and these may be much more directly concerned in any action at a distance. To begin with, as far as solar spots go, every observer can see directly whether he has to do with an active or quiet spot. Again, he can see whether, on rounding the edge of the disc, the neighbourhood of a spot is studded with eruptive prominences or surrounded by brilliant faculæ, but both these he may see without a spot being visible near. But if no spot is visible, and these eruptive prominences and brilliant faculæ (indicative of a solar storm much more than the dark spots *per se*) are well within the sun's disc, their discovery is not so easy, and I feel sure that many tremendous outbursts are thus entirely lost to direct telescopic or spectroscopic observation. Even then we have no absolute evidence that distortion and reversals of lines, &c., constitute, with disturbed spots, the whole range of solar storm phenomena, and we are in entire ignorance as to what extent electric potentials of unsuspected magnitude may enter the arena of the upheaval. These electric contributions are so far entirely invisible to us, but the belief in their actual existence is none the less justified.

Therefore I do not see what purpose is served by debating as to whether one or another particular solar longitude of a sun-spot is the more productive of terrestrial magnetic storms. At the same time one might argue, theoretically at least, that the line of least resistance would be also the *shortest* connecting line between sun and earth, and that, therefore, *near* or *on* the central meridian a solar disturbance (not necessarily a spot) may have an enhanced effect.

In these debates on the relationship of solar phenomena and terrestrial magnetism, I notice that any attempt to account for the following circumstances is invariably left out of consideration:—

(1) How is the incontrovertible fact explained that terrestrial magnetic storms do not only synchronise with the spot cycle *in toto*, but accumulate in two annual maxima about the equinoxes?

(2) Why should a solar south latitude disturbance more frequently prove effective on the earth's magnetic condition in March (spring equinox) than a north latitude disturbance, and the reverse take place at the autumn equinox?

(3) How is it that terrestrial magnetic storms recur in subordinate periods, synchronous with the sun's sidereal rotation period, almost corresponding to the respective latitude of the solar disturbance; and why should this same subordinate synchronism be more strikingly apparent during the spring and autumn equinoxes?

Possibly a correct answer to question 1 would settle the second portion of question 3, but unless these three main questions can be satisfied, I feel bound to say that whatever be the immediate cause of the terrestrial magnetic disturbance, *this cause must be located on the sun* or in extremely close proximity to its photospheric surface; must partake of its rotation, differentiated according to latitude; must be more effective in spring and autumn through more favourable relative position of sun and earth; and, finally, must be synchronous with the spot period as a whole. Here then I part company with Mr. Sidgreaves, inasmuch as he says on page 91, *loc. cit.*:—

"It seems therefore true that recorded observations, while clearly asserting a real connexion between sun-spots and magnetic storms, *are against any theory which places the cause of magnetic disturbance within or near the sun.*"

Helmholz's theory placed the cause of the sun's sustained heat radiation on that body itself. From the sun we also receive nearly all our light, and I do not see why we should show such hesitation to credit it also with sufficient electromotive force to influence the earth's magnetic condition. Could we but have an analyzing magnetoscope, after the analogy of the analyzing spectroscope, which would enable us *to watch magnetically any selected portion* of the sun's surface, we might come immeasurably nearer to a solution of this vexed question.

ALBERT ALFRED BUSS.

XUM

P.S.—While no spots have been visible for some months now, the chromosphere seems to show a very rugged appearance lately, especially in the polar regions. A friend of mine has advised me to let the sun's light pass through a ruby-tinted glass when observing prominences, etc., in the Hα (C) line, and I must say that it greatly assists me in obtaining good views, and I recommend the simple device to brother spectroscopists.—A. A. B.

British Ornithological Notes.

Conducted by HARRY F. WITHERBY, F.Z.S., M.B.O.U.

Greenish Willow Warbler (Phylloscopus viridanus) in Scotland.—At the October meeting of the British Ornithologists' Club, Mr. Howard Saunders exhibited, on behalf of Mr. W. Eagle Clarke, a male specimen of this little Warbler. It struck the lantern of the Suleskerry lighthouse on September the 5th last. Suleskerry is a storm-swept rock about 35 miles from the nearest point of Sutherland. This specimen is the second example of the species obtained in Great Britain, the first having been shot by Mr. Caton Haigh in Lincolnshire, on September 5th, 1896. The Greenish Willow Warbler has been known to occur only some half-dozen times in Western Europe, although it breeds no further off than a little to the north-east of St. Petersburg. Its true summer home, however, is in the Urals and further east.

White-spotted Bluethroat in Kent.—The White-spotted Bluethroat is the southern form of the Red-spotted Bluethroat which inhabits arctic Europe and Asia, and often visits our southern and eastern coasts at the times of migration. The white-spotted form (*Cyanecula leucocyana*) had not been recorded for Great Britain until October last, when Mr. M. J. Nicoll exhibited a specimen of the bird to the British Ornithologists' Club. This specimen was picked up dead close to Dungeness lighthouse by a man named Gasson, on October 6th, 1902.

White-winged Lark (Alauda sibirica) in Kent.—Two examples of the White-winged Lark were obtained at Woodchurch, Kent, on January 27th and 28th, 1902, and at the time a third bird was seen. This was obtained on March 22nd. All three specimens have been exhibited by Mr. N. F. Ticehurst to the British Ornithologists' Club. Previous to these examples, the White-winged Lark had been obtained only once in the British Islands, namely, near Brighton, in November, 1869.

Rustic Bunting (Emberiza rustica) in Sussex.—The fourth example of this eastern species to be obtained in Great Britain was exhibited by Mr. N. F. Ticehurst at the October meeting of the British Ornithologists' Club. The bird was a young male, and was shot by a boy at North Croft Farm, Westfield, Sussex, on September 22nd, 1902.

Little Bunting (Emberiza pusilla) at Tees Mouth, Co. Durham (*Naturalist*, November, p. 353).—Mr. C. E. Milburn records the occurrence of a bird of this species on October 11th, on the Durham side of the Tees mouth. The specimen, which is a female, was exhibited by Mr. W. R. O. Grant at the October meeting of the British Ornithologists' Club. The Little Bunting breeds in Northern Russia, and has only once before been recorded as occurring in Great Britain.

Aquatic Warblers (Acrocephalus aquaticus) in Sussex.—At the October meeting of the British Ornithologists' Club, Mr. Bonhote exhibited a pair of Aquatic Warblers, shot at Winchelsea, Sussex, last August. The bird, which breeds in France and Germany, has been previously noticed some half-dozen times in England.

Lesser Grey Shrike (Lanius minor) in Norfolk.—At the October meeting of the British Ornithologists' Club, Mr. G. E. Lodge exhibited a young specimen of *Lanius minor*, which he had shot on October 11th, at Docking, in Norfolk. The Lesser Grey Shrike, which is an annual summer-visitor to Southern and Central Europe, occasionally wanders to England at the migrating seasons.

Glossy Ibis in Hampshire and Sussex.—Mr. Edward Buckell writes that a Glossy Ibis was shot near Romsey, Hants, on October 19th last; while Mr. F. Ashburnham records (*Field*, November 8th, 1902, p. 808) that a specimen was shot near Rye at the beginning of October, and another in Pevensey Marsh, in Sussex, in the middle of October.

Red-necked Phalarope in Anglesea.—In the course of an interesting article on the birds of Anglesea, Messrs. T. A. Coward and Charles Oldham describe how they watched a bird of this species, on June 5th and 6th, on a shallow pool. Although it still breeds in the islands in the north of Scotland, the Red-necked Phalarope strangely enough is seldom recorded from England, and less often from Wales, in spring, although those countries lie between the birds' winter and summer quarters. The authors of this paper draw attention to a conspicuous white spot above the eye of the bird, which was distinctly noticeable in the live bird, but, they say, is practically obliterated in dried specimens, owing to the contraction of the skin over the orbit.

Great Bustard near Cambridge.—A Great Bustard was shot near Cambridge, on September 25th last. This was presumably one of the birds which were put down in Norfolk in 1900 in the hopes that the species would re-establish itself in its former haunts (*see* KNOWLEDGE, 1900, October, p. 230). Several of these birds, unfortunately, have now been shot by ignorant people. In the present case, the farmer who shot the bird, when convicted of the offence, expressed his regret, explaining that he did not know what the bird was, and had not seen any of the notices which had been published in the neighbourhood in order to draw attention to the presence of the bird, and to ask for its protection. If those directly interested in the reintroduction of this fine bird will persist in their efforts by importing a few pairs of birds each year, and advertising their presence, there is every reason to hope that the experiment will prove a success. In a few years' time, perhaps, it will not be necessary for us to go all the way to Spain to see the finest bird on our game list.

Alpine Swift in Kent (*Field*, November 1st, 1902, p. 761).—Mr. H. S. D. Byron states that an Alpine Swift was shot at Thanet on October 21st, but he gives no particulars of the bird.

All contributions to the column, either in the way of notes or photographs, should be forwarded to HARRY F. WITHERBY, *at the Office of* KNOWLEDGE, 326, *High Holborn, London.*

ASTRONOMICAL.—The repetition of Foucault's pendulum experiment at the Pantheon in Paris has attracted considerable attention, though it is only remarkable for the large scale on which the experiment is performed. It may not be generally known that there is a permanent exhibition of the experiment in the Science Collections of the Victoria and Albert Museum at South Kensington, where the demonstration of the earth's rotation is completely satisfactory, in spite of the fact that the pendulum wire is only 40 feet in length, as compared with the 220 feet of the Pantheon experiment. Excellent results have also been obtained by the writer of these notes with a carefully suspended pendulum not more than seven feet in length, the deviations being often correctly shown for three-quarters of an hour.

Following up a general solution of an equation due to Laplace, Mr. E. T. Whittaker, one of the secretaries of the Royal Astronomical Society, has been led to the important conclusion that gravitation is in all probability propagated by undulations in the same medium by which light is transmitted through space. This undulatory theory requires that gravity should be propagated with a finite velocity, but this velocity need not be the same as that of light, and may be enormously greater. Mr. Whittaker is careful to point out that his investigation does not explain the *cause* of gravity, but shows that the propagation across space of forces which vary inversely as the square of the distance does not require for its explanation any new property of the transmitting medium. The development of the theory will be awaited with the greatest interest.—A. F.

BOTANICAL.— The "Origin of the Deadnettles in Britain" is discussed by Mr. S. T. Dunn in a paper which originally appeared in the *South-Eastern Naturalist* for 1901. He divides the species found in the British flora into three groups. The first includes *Lamium galeobdolon* alone, as this is the only British species found naturally in our woods; the second group includes *L. album*, *L. purpureum*, *L. incisum*, *L. amplexicaule*, and *L. intermedium*, all of which are unknown in Britain except in places prepared unintentionally for them by man; and the third consists of *L. bifidum*, seeds of which were introduced with foreign corn, and *L. maculatum*, which originated as an escape from gardens. *L. galeobdolon* is distributed through Western Siberia and Europe (including southern and central England), but is unknown in the most northerly regions. It is supposed that it spread into this country from the continent at the end of the last glacial period, before man had made his appearance in North-western Europe; it is, therefore, regarded as truly indigenous in Britain. Mr. Dunn shows that the extremely common White Deadnettle (*L. album*), and the other species associated with it in the second group, were introduced by the agency of man. The White Deadnettle is widely spread in the North Temperate Zone, both as a native and as a weed. It naturally grows in woods and forests, but in the British Islands it is not known in these habitats, though common enough wherever the ground is subjected to periodical disturbance. The Purple Deadnettles (*L. purpureum* and *L. incisum*) are weeds in Britain, and are commonly found as such throughout Europe, North Africa, the Orient, and Siberia. *L. amplexicaule* is unknown except as a weed of cultivated ground, and Mr. Dunn suggests that it has been derived from *L. macrodon*, a native of the cedar forests of Asia Minor, which, on extending its range into cultivated ground, became somewhat modified by its altered surroundings. *L. maculatum*, though clearly non-indigenous in Britain, is wild in the woods of Southern Belgium. This interesting paper has been reprinted in the October number of the *Journal of Botany*.

Two British local floras have recently been published, one dealing with the Liverpool district and the other with the East Riding of Yorkshire. The first, edited by Dr. C. T. Green, includes the plants growing within fifteen miles of the Liverpool Town Hall and two miles of Southport. It is based on the "Flora of Liverpool," issued by the Liverpool Naturalists' Field Club in 1872; but the present work contains several new features. A most useful one is the addition of pretty little figures of most of the plants. Further, there are twenty-one photographs of the scenery of the district. The flowering plants, ferns, fern allies and Characeæ included in the flora amount to 1060 species. The "Flora of the East Riding of Yorkshire," by J. F. Robinson, contains 1035 species, including 137 aliens, casuals, etc., and 20 "incognita." Mention should also be made here of Mr. F. H. Davey's "Tentative List of the Flowering Plants, Ferns, etc., known to occur in the County of Cornwall," which was issued a few months ago. —S. A. S.

ZOOLOGICAL.—The opinion seems to be gaining ground among zoologists that there are two distinct forms of okapi. In the October issue of the *Proceedings* of the Zoological Society, Dr. Forsyth Major applied the name *Ocapia liebrechtsi* to the form represented by a male skull from the Congo Free State, recently received in Brussels. On the other hand, Prof. Ray Lankester (*Ann. Mag. Nat. Hist.* for November) believes this form to be the true *O. johnstoni*, as typified by the strips of skin described by Dr. Sclater as *Equus (?) johnstoni*. Accordingly he proposes the name of *O. erikssoni* for the form represented by the mounted specimen in the British Museum, hitherto assigned to the typical species. Dr. Major has further stated that the female *O. johnstoni* (= *liebrechtsi*) is horn-less; and the same will probably hold good for the other form. Assuming this to be the case, and also admitting the existence of two distinguishable forms, it has yet to be proved that these are anything more than local races of a single species.

In a paper recently published in the *Proceedings* of the Royal Physical Society of Edinburgh, Mr. O. C. Bradley proposes a system of skull-measurements for mammals, analogous to the "craniometry" employed in the case of the human subject.

Certain very remarkable prehistoric sketches of animals from the cave of Font-de-Gaume, in the Dordogne, are reproduced and described by Messrs. Capitan and Breuil in a recent issue of the *Comptes Rendus* of the Paris Academy. The animals depicted are the reindeer and the Pleistocene bison. Consequently, if genuine, the drawings must apparently be assigned to the Palæolithic epoch.

Much interest attaches to the description by Dr. C. W. Andrews (*Geological Magazine* for October) of a series of vertebrate remains—chiefly mammalian—from a Pliocene deposit on the Wadi-Natrun, Egypt. The remains include those of a three-toed horse (*Hipparion*), of a hippopotamus identified with a species previously described from a formation of the same age in Algeria, of an antelope apparently inseparable from the *Hippotragus cordieri* of the South of France, and of an undetermined species of pig. This new fauna apparently confirms previous conclusions as to a land-union between Europe and North Africa in Pliocene times.

Those who would explain the distribution of certain forms of life by the former existence of a land-connection between the southern continents by way of "Antarctica," have laid some importance on the existence of fishes of the genus *Galaxias* in the freshwaters of New Zealand, Australia, South America and the Cape. This evidence, for what it is worth, has been completely shattered by Mr. G. A. Boulenger's description (in a memoir on the fishes of the Congo) of a marine representative of the genus in question from the Southern Ocean.

In a memoir recently published at St. Petersburg, Dr. Otto Herz describes the journey of the expedition under his charge to the Beresowka River, in North-eastern Siberia, to exhumate and bring home the remains of a frozen mammoth. Although the carcass had lost the trunk and one of the tusks before the arrival of the party, the expedition was a complete success, having reached the Beresowka and completed its task before the setting in of the winter frosts. Leaving the Beresowka in November, the party reached St. Petersburg in February last, where they made over their spoils to the Academy of Sciences.

Another memoir lately published at St. Petersburg is devoted to a full description of the wild horse of Mongolia, based on the rich series of specimens in the museum and on examples living at Moscow. The author, Dr. Salensky, is convinced that *Equus przewalskii* is a distinct animal and not a hybrid, but does not decide whether it is a separate species or merely a local or feral race. In the course of his description the author mentions the interesting fact that the callosities generally present on the hind legs are wanting in some individuals of the domesticated horse and the wild tarpan. Commenting on the memoir in the *Field* newspaper, Mr. Lydekker expresses the opinion that the Mongolian wild horse can no longer be regarded as anything more than a race, or sub-species, of *Equus caballus*.

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In the journal last mentioned (October 4th and 11th) the same writer discusses the coloration of the larger mammals, and concludes that in most instances this is designed for the purpose of protection, by harmonizing with the inanimate surroundings. It is pointed out that forest-dwelling animals may nearly always be distinguished by the large size of their ears, as compared with those of their nearest relatives. The need of accurate observations in the field with regard to the meaning and use of animal coloration is urged, and the assistance of sportsmen and travellers in clearing up matters of doubt invited.

In a note on the Pleistocene fauna of Nebraska, published in Vol. XVI. of the *Bulletin* of the American Museum, Mr. W. D. Matthew describes, under the name of *Capromeryx*, a new type of ruminant, which is regarded as the direct ancestor of the American prongbuck (*Antilocapra*). The author considers that both animals are descended from a group of ruminants termed "antilopine deer"; that group being characterised by the possession of antlers approximating to those of the deer, coupled with teeth more like those of antelopes. The antlers, which are forked or several times branched, are provided usually, or invariably, with a "burr," whence it would appear that they were annually shed. On the other hand, they are smooth, which suggests that they were permanently invested with "velvet." In another communication to the same journal Mr. Matthew describes the skull of a rodent from the Tertiary of Colorado provided with three horns. For the animal to which it belongs he proposes the name *Ceratogaulus*. A horned rodent is a type quite new to science.

Number 466 of the *Proceedings* of the Royal Society contains an abstract of Dr. W. G. Ridewood's important memoir on the structure of the gills of the bivalve molluscs. No less than 215 species, referable to 118 genera, were examined in order to determine the structure of the gills. Speaking generally, neither the minute structure nor the mode of arrangement of these organs is of much value in classification; although three main types of gill-structure, apparently representing as many grades of complexity, can be recognised. The first and simplest of these types is met with only in the families *Nuculidæ* and *Solenomyidæ*, which have consequently been brigaded together under the name of Protobranchia.

THE Gordon Memorial College at Khartoum, which Lord Kitchener opened on November 8th, is now ready for the Chemical and Bacteriological Research Laboratories presented by Mr. Henry S. Wellcome during his recent visit to the Soudan. The fixtures and appliances made in England have already been shipped. The equipment for scientific work is most complete and should be equal to any similar laboratories in Europe. The Sirdar has appointed as Director of these Research Laboratories, Dr. Andrew Balfour, of Edinburgh. The Soudan presents exceptional opportunities for the study of tropical diseases, especially malaria, typhoid and dysentery, and the results of the investigations of Dr. Balfour and his staff should be of considerable importance. Dr. Balfour will also assist the authorities in the investigation of the criminal poisoning cases which are frequent in the Soudan. The character of the poisons used by the natives is at present often obscure, and it is possible that the work in these laboratories may increase our knowledge of toxic agents. Apart from the original researches and general sanitary work, Dr. Balfour and his staff will devote their attention to the study of the cereals, textile fibres, and various matters affecting the development of the agricultural and mineral resources of the country.

Notices of Books.

"ASTRONOMY WITHOUT A TELESCOPE." By E. Walter Maunder, F.R.A.S. (KNOWLEDGE Office.) Illustrated. Pp. xii. and 280. 5s.—There are many classes of readers to whom, we believe, Mr. Maunder's new book will appeal strongly. Those who wish to gain a close personal acquaintance with the stars will find themselves provided with an excellent set of star maps, and conducted by one who has a thorough knowledge of the heavens; those interested in the names of stars and constellations will find an admirable account of their origin and significance, as far as they can be traced; and the many who will doubtless wish to turn their knowledge of the stars to good account will find numerous valuable suggestions as to fields of research in which the unaided eye is not only competent to yield results of value to science but is often the only suitable means of observation. "Astronomers without telescopes" may be roughly divided into two classes, which may be briefly described as "fireside astronomers" and "open-air astronomers." Many useful investigations have been made by some of the former, and may still be undertaken by them with advantage; but it is to assist those desiring to make observations for themselves that the author's efforts are chiefly directed. Even if the observations are restricted to phenomena which are already perfectly well known and understood, the observer will in this way acquire a knowledge which no amount of reading could ever supply; but with Mr. Maunder's guidance he will find it possible to go further and take a share in various astronomical inquiries. Following chapters on the constellations, full and thoroughly practical directions are given for astronomical exercises intended primarily for the "education" of the reader, and these are appropriately followed by suggestions as to the systematic observation of meteors, the Zodiacal Light, Auroræ, the Milky Way, and other phenomena for which no telescope is necessary. That there are so many investigations open to the astronomer without a telescope is perhaps one of the most important lessons which the book brings home to us, and, as the author points out, there is a real danger that such observations may be neglected in view of the widespread attention attracted to the work of the great instruments which have been set up in recent years. Readers of KNOWLEDGE will recognise in the book much which has already appeared in our pages, but it may be mentioned that the original articles have to a large extent been rewritten and new illustrations included. We think that many of those who are thus already familiar with the general scope of the work will be glad to have the papers in a collected form, and it is confidently believed that the book will attract a wide circle of readers, and materially contribute to the advancement of several branches of astronomy.

"BIRDS IN THE GARDEN: STUDIES WITH A CAMERA." By Granville Sharp, M.A. (Dent.) Illustrated. 7s. 6d. net.—Mr. Sharp has written a very pleasing and entertaining little book on a few birds to be found in almost any garden. With the use of very simple photographic apparatus, and a few contrivances for bringing the birds within range of the camera, he has managed to secure an excellent series of pictures of the birds about which he writes. These photographs show very well how varied are the attitudes of birds and how expressive those attitudes often are. Photographs of this description are so much more interesting and valuable than those of birds and animals in ordinary "quiet" attitudes. Take, for instance, Fig. 33, where some young Great Tits are shown sunning themselves. The author says, "They went about it quite deliberately, flying over to a part of the garden that they otherwise neglected, just where a slope in the ground caught the full blaze of the sun. Here they would spread themselves out two or three at a time, settling their feathers edgewise to the sun, so as to take in all the heat they could." For the photographs themselves we have nothing but praise, but Mr. Sharp has been most unfortunate in the way the block maker has treated the results of his skill and patience. The backgrounds have in most cases been cut away, presumably by the mechanical "process engraver." In this work no discrimination has been made in many cases between parts of the birds and parts of the background, and as a consequence, in some of the illustrations portions of the background have been left as though they belonged to the birds,

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while, in others, parts of the birds have been cut away in mistake for the background. In this way, many of the photographs have been spoilt, and we need only instance the figures opposite to page 46, where the legs, beaks, and tails of the birds have greatly suffered by this merciless pruning. We hope that a favourable reception of his book will induce Mr. Sharp to give us further "chats" about the birds of his garden, and that no mechanical engraver will be allowed in future to "improve" the photographs.

"EXPERIMENTS IN AERO-DYNAMICS." By S. P. Langley. (Published by Smithsonian Institution.)—This classical work reappears in a fresh edition, with but little addition to the subject matter as published in 1891. The central fact, on which depends the importance of the long and exhaustive experiments dealt with, is practically a refutation of the statement found in elementary text-books, that if a ball be shot from a cannon horizontally at any given height above the ground, and if a second ball be dropped vertically at the same instant as the discharge, the two projectiles will reach the ground at the same time. Substituting for the cannon ball a thin material plane projected horizontally in its own plane, Prof. Langley shows that the body behaves almost as though deprived of weight, supplying thereby a phenomenon possibly analogous to that of the rapid skater travelling in safety over thin ice. The general conclusion to which the master experimentalist is led is that we already possess in steam engines as now constructed, or in other heat engines, more than the requisite power to urge a system of rigid planes through the air at a great velocity, making them not only self-sustaining but capable of carrying other than their own weight. The volume must remain one of the most unique and valuable of the Smithsonian contributions to knowledge.

"AERIAL NAVIGATION." By Frederick Walker. (Crosby Lockwood & Son.)—The author of this unpretending little volume, "the aim of which," we are informed, "is to convey elementary instruction in a popular manner," has succeeded in packing a certain amount of useful and practical matter within its hundred and fifty pages. The opening chapter introduces us to a comparison of the capabilities of winged creatures, from the albatross to the flying fish, and is of a readable nature. The succeeding chapters, however, dealing with Aerostatics and Aerodynamics, are, unfortunately, difficult to follow, giving the idea of having been compiled in too great haste. In addition to mere slips of the pen, there are loosely-worded sentences which are ungrammatical or obscure, and instances where formulæ are faulty and statements or reasoning inaccurate. As examples we may point to the following:—"Altitude in feet (A) may be computed from the log. of barometer reading in inches (b) from the formula $4771 - b \times 6{\cdot}000 \times t = A$, where 4771 is 30 log.," and to a very remarkable sentence or two on page 16. A chapter dealing with air-ships is copiously illustrated and well compiled for the purposes of a technical manual. Whether the little volume will be found to be really what it professes to be —"a practical handbook on the construction of dirigible balloons, aerostats, &c."—may perhaps be doubted, but it is not without information valuable to the mechanic, and contains useful tables which will be handy for reference.

"THE PRIMROSE AND DARWINISM." By A Field Naturalist, M.A.(CAMB.). xiv. + 233 pp. (Grant Richards.)—It will be admitted that an author sets before himself no easy task when he tries to show that Darwin's famous observations on the cross-fertilisation of flowers were for the most part faulty, and that the accepted theories, based on these observations, are unscientific and absurd. Such, however, is the object of the present book. The author repeatedly criticises Darwin's use of the net to exclude insects from the flowers under observation; yet he does not, we believe, bring forward any experimental evidence that the net really has the sterilising influence he attributes to it. He is surely acquainted with the method of blank experiment! Similarly, commenting upon Fritz Müller's observations upon orchids, he says the flowers were, "in all probability, under protection in a greenhouse," and then proceeds to criticise the "probable" conditions of the experiments. Further, in face of Darwin's explicit statement that "the cowslip is habitually visited during the day by the larger humble-bees, and at night by moths," the critic includes the cowslip in a list of "a dozen of our brightest and most conspicuous common flowers which are rarely, and in some cases never, visited by bees at all." It is interesting, therefore, to find the anonymous author declaring that "for Darwin to set up as a judge in Nature's divorce court . . . transgresses a little, we think, the bounds of modesty." In spite of the flaws we have indicated, we believe Darwin would have been the first to welcome this volume. It at least makes clear the necessity for further investigation of the subject. The twenty-three illustrations are admirable.

"ASTRONOMY WITH AN OPERA-GLASS. A Popular Introduction to the Study of the Starry Heavens with the Simplest of Optical Instruments." By Garrett P. Serviss. Eighth Edition. (Hirschfeld Brothers.)—This is a re-issue of the eighth edition, published by D. Appleton and Co. in 1896. Instead of the dark-blue cover of the earlier book, where fair Andromeda hangs chained in a starry sky, and a pair of opera-glasses occupies the right-hand corner of the foreground, the volume is now clothed in green with a picture of Saturn and his Rings, in exact conformity with "The Pleasures of a Telescope," and "Other Worlds," by the same author. This cover is not so appropriate to this book as to the others, since Saturn offers no opportunities to the astronomer with an opera-glass, save that of tracing his slow motions through the stars. Those who have read anything from Mr. Serviss' pen will not need any recommendation of the present volume. His close acquaintance with, and enthusiasm for his subject, his fresh and easy style, render all his writings attractive, and he is especially at home in the subject of this present volume. He has not confined himself in it to a mere description of the objects as they may be seen with a binocular, but has supplemented it by what has been learned concerning them by means of more powerful instruments, and by the histories, folk-lore, and traditions that have come down to us concerning them. Perhaps the most interesting account in a book where there is nothing dull is that of the Pleiades. He relates the traditional or proved changes in the brightness of the various stars and of the nebula; of Merope, who married a mortal and whose star therefore became dim amongst her sisters; of Electra, whose tears at the burning of Troy blotted out her star; of Asterope, the reputed spouse of Mars. Electra is now the brightest star of the group save Alcyone; Asterope is only visible in the glass; whilst Merope now shines plainly to be seen with the naked eye. And from this Mr. Serviss deduces the quite unastronomical moral that, "notwithstanding an occasional temporary eclipse, it is, in the long run, better to marry a plain mortal than a god." In this new issue it is to be regretted that no notice is taken of the changes of the new star in Perseus, nor of the great naked-eye comet of 1901, both of which offered good fields for observation with the opera-glass.

"INDEX TO THE LITERATURE OF THE SPECTROSCOPE (1887-1900, BOTH INCLUSIVE)." By Alfred Tuckerman. 1902.—This is one of the Smithsonian Miscellaneous Collections, and is a continuation of the previous Index by the same author published in 1888. It consists of two parts—Author-Index and Subject-Index. The preparation and publication of these bibliographies places the student under a very heavy debt to Mr. Tuckerman. There seems, however, one criticism to be made on the manner in which Mr. Tuckerman has carried out his task—viz., that the papers catalogued are by no means confined to spectroscopy, but embrace a considerable number relating to general astronomy, selected without any obvious purpose, and, in many cases, not even remotely connected with the title of the bibliography. This is a pity, as, on the one hand, it unduly swells the book, and may often cause the student to refer to papers that have no reference to his special line of research, whilst, on the other hand, it entirely fails to fill the larger programme of a bibliography of astronomy as a whole.

"MANUAL OF ASTRONOMY." By Prof. C. A. Young, PH.D., LL.D. (Ginn & Co.)—Prof. Young has already issued two text-books in astronomy, "The Elements of Astronomy," and "General Astronomy," both of which are models of their kind. The present book is for the use of those who find the first not sufficiently extended for their purpose, but for whom the second is too large for convenience. A most excellent text-book it is, clear, full and yet not redundant, from the "Preliminary Considerations and Definitions," which constitute Chapter I., to the Appendix, giving instructions for

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the calculations of eclipses, and many tables of the elements of the solar system, of comets, of the motions and parallaxes of stars, and of variable and double stars. The index itself is not such as other indexes are, but following the name of each astronomer is the date of his birth if known, and if unknown, a note of interrogation. The date of death is also given, if this has taken place, and if otherwise a long dash acts as a sort of *memento mori*. The text-book is one that will prove of eminent practical value to the working astronomer. We would, therefore, like to see incorporated in its next edition yet more tables and formulæ, such as the astronomer is always needing, and for which he can very rarely trust his unaided memory. The formulæ for the solution of spherical triangles would prove most useful, and it might not be impossible to devote a few pages to a set of four-figure logarithms, an addition which would make the book a most complete one. Prof. Young gives an interesting and serious explanation of the fact that when high in the sky "the moon appears about a foot in diameter." He attributes it to "the physiological fact that our muscular sense enables us to judge moderate distances pretty fairly up to 80 or 100 feet, through the "binocular parallax" or convergence of the eyes upon the object looked at. Beyond that distance the convergence is too slight to be perceived. "It would seem that we instinctively estimate the moon's distance as small as our sense will permit when there are no intervening objects which compel our judgment to put her further off." There are one or two minor errors. Thus on p. 41, the 3-ft. reflector presented to the Lick Observatory by Mr. Crossley was made by Mr. Calver, not by Mr. Common, as Prof. Young says, Mr. Common bought it from Mr. Calver and sold it to Mr. Crossley. And on p. 54, the almucantar is used in England in the University Observatory of Durham, not of Cambridge.

"EXPLANATIONS OF TERMS AND PHRASES IN ENGLISH HISTORY." By W. T. S. Hewett. (Elliot Stock.) This is a very useful companion to the general reader in English history, and the plan of the book is capable of considerable extension. Some of the definitions are loose and inadequate, but we hope the compiler may be encouraged to return to the subject, when we would suggest the insertion of authoritative definitions wherever that is possible.

THE *Irish Naturalist* for November is devoted to a special report of the British Association meeting at Belfast. A general account of the meeting, and of the papers read and excursions made, is given, but the valuable part of the report consists of the abstracts of papers dealing specially with Irish natural history, read in the sections devoted to geology, zoology, geography, and botany. Irish naturalists, and all interested in the natural history of Ireland, should procure a copy of this issue of our contemporary.

MESSRS. F. E. BECKER & Co., of Hatton Wall, have sent us an elaborate catalogue of balances, scales and weights, containing more than one hundred pages of illustrated descriptions of all kinds of balances and weights used in scientific work. The educational value of practice in the exact use of accurate balances is great, and the introduction of this work into the schools may be induced by the production of such instruments for the use of students at reasonable prices. We would recommend all those who are interested to obtain a copy of this catalogue.

WE have received from Messrs. Isenthal & Co. a copy of the Catalogue of Max Kohl, of Chemnitz, for whom they are sole agents in the United Kingdom and its Colonies. This remarkable catalogue covers probably all instruments required in the various branches of physics, as well as apparatus for chemistry.

BOOKS RECEIVED.

Structure of the Universe (The Rede Lecture, June 10th, 1902). By Osborne Reynolds, M.A., F.R.S. (Clay.) Illustrated. 1s. 6d. net.

School of the Woods. By William J. Long. Illustrated by Charles Copeland. (Ginn & Co.) 7s. 6d.

Text-Book of Physics. By J. H. Poynting, SC.D., F.R.S., and J. J. Thomson, M.A., F.R.S. (Chas. Griffin & Co.) Illustrated. 10s. 6d.

Agricultural Industry and Education in Hungary. Compiled by T. S. Dymond. (Chelmsford: County Technical Laboratories). Illustrated. 2s. 6d. net.

Elementary Photo-Micrography. By Walter Bagshaw. (Iliffe.) Illustrated 1s. net.

A Naturalist in Indian Seas. By A. Alcock, M.B., LL.D., F.R.S. (Murray.) Illustrated. 18s. net.

Dominion of the Air. By the Rev. J. M. Bacon. (Cassell.) Illustrated. 6s.

Advanced Hygiene. (The Organized Science Series.) By Alfred E. Ikin, B.SC.(HONS.)LOND., L.C.P., and Robert A. Lyster, M.B., B.CH., B.SC.LOND. (University Tutorial Press, Ld.) Illustrated. 3s. 6d.

"*Eyes Within.*" By Walter Earle, M.A. (Allen.) 5s. net.

Practical Landscape Photography. By G. T. Harris, F.R.P.S. (Iliffe.) 1s. net.

Religion as a Credible Doctrine. By W. H. Mallock. (Chapman & Hall.) 12s.

Modern Spiritualism. By Frank Podmore. (Methuen.) Vols. I. and II. 21s. net.

Photograms of the Year, 1902. (Dawbarn & Ward.) 3s. net.

Rise of the Experimental Method in Oxford. By Prof. Clifford Allbutt, M.D., F.R.S. (Frowde.) 1s. net.

Variation and Correlation of the Human Skull. By Cicely D. Fawcett, B.SC., assisted by Alice Lee, D.SC. (From *Biometrika.*)

Proceedings of the Yorkshire Geological and Polytechnic Society. Edited by W. Lower Carter, M.A., F.G.S., and William Cash, F.G.S. (Leeds: Chorley & Pickersgill.)

Journal and Proceedings of the Royal Society of New South Wales. Vol. XXXV., 1901. (London: Robertson Proprietary.)

Encyclopædic Dictionary. (Cassell.) Part I. 6d. net.

Fiction of the Ice Age or Glacial Period. By Francis D. Longe. (Lowestoft: McGregor & Fraser.)

Report on the Work of the Department of Technology, City and Guilds of London Institute. (Murray.) 1s.

Publications of West Hendon House Observatory, Sunderland. By T. W. Backhouse, F.R.A.S. (Sunderland: Hills & Co.)

Chronographical Table for Tobacco. Dr. Prof. O. Comes. (R. Scuola Superiore d'Agricoltura, Portici, près Naples.)

The Riddle of the Universe. By Ernst Haeckel. (Watts.) 6d.

New Catechism. By M. M. Mangasarian. (Watts.) 6d.

Force of Mind. By A. T. Schofield, M.D., M.R.C.S. (Churchill.) 5s. net.

Photography. Xmas Number. (Iliffe.) 1s. net.

THE BACKBONE OF LEINSTER.

By GRENVILLE A. J. COLE, M.R.I.A., F.G.S.

THE Backbone of Leinster has been previously referred to* as a typical Irish representative of the great Caledonian folds, which run north-east and south-west across so many mountainous regions in our islands. It is the most continuous feature of eastern Ireland, and its rounded summits, clad with heather, and from 2000 to 3000 feet above the sea, rise from a moorland seventy miles in length.

As I write in my study on the little ridge of Tulla, *Tulach-na-nespuc*, the meeting-place of Irish and of Dane, I look across the rough hedgerows and the valley, to where the gorse flares on the first slopes of Carrickmines. The granite crops out in bare knobs among the bushes, and forms, with its smooth natural slabs, a paving for the paths across the hills. On the left rises the grey quartzite cone of Carrickgollogan, and from this point the ground falls to the wooded demesnes along the sea. On the borderland, a square grey tower stands suggestively, a castle of the English Pale, set between the cultivated lowland and the moor.

On the right of this broad landscape, the great dome-like mountains rise, one beyond another, the first promise of the wilds of Leinster. We can see the bare granite again on the slopes above Glencullen; and after that it is almost all granite, away south-west through Carlow, and down to the heart of Waterford. The highest point visible in the distance is Douce Mountain—pronounced Djowse—2384 feet above the sea. Long after the foothills have become green in springtide, Douce may gleam white in the morning sunlight, and tell us that fresh snow has fallen all along the range.

* "The Structure of Ireland," KNOWLEDGE, Vol. XXI. (1898), p. 76.

It is hard to believe that the streets of Dublin lie only seven miles away in the great limestone plain; and Dublin has always known and felt the nearness of the Leinster moors. Even to this day, the coast and port, and the lower valley of the Liffey, are largely held and worked by men of English names; the highland that calls us out from Dublin at the end of each southward-stretching avenue is still, to all intents, the land of the O'Tooles and the O'Byrnes.

The mouth of the Liffey, and the deltas of old glacial gravel along the shore, were an obvious temptation for the Norse invaders. After plundering the islands, the sea-kings grew bold and settled on the land; they found Dublin a group of green raths guarding a river-ford, and they made it a busy port and city. None but a sea-faring people need have used Dublin as their capital. The central Irish fell on it from time to time, and the Scandinavians sought safety in alliance with the hill-men. Even Brian, after a month of plundering, left the city to be reoccupied by the enemy; to be king in Ireland was to be lord of the great central plain. And thus it came about that the Normans, in 1170, took Dublin from their old Norse kinsfolk rather than from the Irish.* From first to last, Dublin was a stronghold of the stranger.

Strongbow's Normans, with his southern allies, actually surprised the city by coming down on it across the granite hills. Out of the same hills, and creeping through the woodland, on a fatal day forty years later, the O'Byrnes and O'Tooles in turn fell on the men of Dublin. Two hundred years passed, in which the English forces were again and again broken on the highland, and still a battle had to be fought at Bray, at the seaward end of the landscape we have just described, where the O'Byrnes were taught for a time to regard the limits of the Pale.

Within their highland, however, they were always safe enough. The great fight in the ravine of Glenmalure, where Lord Grey's army was shot down by hidden musketry, reads like an Elizabethan version of some mishap in the late Boer war. In 1591, again, young Hugh Roe O'Donnell fled from his prison in Dublin straight to the unconquered hills; and few will grudge him his successes of the next ten years. In the bitter and unreasoning days of 1798, six centuries after Strongbow captured Dublin, the Backbone of Leinster was still to be reckoned with, as the natural rival of the plain.

Strangely enough, and yet appropriately, the denuding forces of rain and rivers, and the storm-winds that swirl, from south-east or south-west, round the northern angle of Slieve Roe, are still bringing to light the features of an older Ireland. Eras ago, the region was covered by the muds of a Silurian sea, and graptolites possessed what now is solid land. Then came the great stresses of the Caledonian folding, and the beds were crumpled from south-east to north-west, in common with those of Wales, the Lake District, and Scotland. Judging by the features laid bare in the Scotch Highlands, and to some extent repeated in Donegal, this epoch of earth-movement produced veritable mountain-chains. The mass of upheaved sediment was at any rate sufficient to allow of the consolidation of granite beneath its arches as it came to rest; while the upward folding went on, the igneous magma followed, and occupied the hollows of the rising chain.†

This profound change in the geography of the British area occurred without obvious warning. It is true that volcanic eruptions had converted the Welsh Sea into an archipelago in Ordovician times, and cones were spouting out lava and scoriæ both north and south of the site of Dublin. But the Gotlandian (Upper Silurian) period had been far more peaceful. One little volcano exploded in the west of Kerry, where its tuffs and agglomerates are brilliantly seen at the present day; but the sea-floor showed no sign of upheaval till near the end of the period, and the ash-beds of Ordovician times were already safely buried in marine deposits. Then came the great waves of the earth's crust, rising in some places only to subside again, but in others perpetuated, where they struck on some resisting mass below. An old north-western Archæan continent probably provided the obstacle in our area; and Cambrian, Ordovician, and Gotlandian beds were thrust against it, and were pressed over one another as the waves continued to advance. Forced up by the same earth-pressures, molten matter flowed in from below, attacking the walls of its caldrons and oozing into every crevice. When this matter ultimately cooled, the long anticlinals remained supported by solid granite cores.

This was the state of things when the Devonian lakes began to gather in the hollows of the land. A certain settlement of the ground assuredly went on, since no new continent can become at once exactly balanced amid all the complexities of the crust. The volcanic eruptions which left such traces in the Scottish Old Red Sandstone, and of which we have hints in Kerry and Tyrone, probably mark the weak lines in the Devonian land. Besides the actual tuffs and lavas, a multitude of dykes, and new intrusions of granite, cut through the Caledonian folds, and show us the dangers to which the continent was exposed. The vast thickness of the Old Red Sandstone indicates, moreover, that the lake-floors were steadily sinking as deposition went on in them.

Thus it came about that the sea again asserted itself, and marine beaches and mud-flats spread across the Devonian layers. For a long time certain high masses stood out as promontories and islands, and the rivers continued to wear them down, and to add their *débris* to the conglomerates forming on the shore. Judging, however, from the occurrence of remarkably pure beds of marine limestone close against masses of Caledonian land, atmospheric denudation was not very active, and the corals and other organisms flourished undisturbed in littoral waters. At the north end of the Leinster Chain we have the most complete proofs, often referred to by geologists, that the denuding forces had already worked down to the granite core. In one or two quarries between Dublin and the hills, lumps of granite occur scattered in the limestone, together with flakes of altered Ordovician shale. Some difficulty has been raised as to how these materials came down in isolated patches from the mountains; but they may represent the last relics of submerged granite knobs, just as banks of subangular gravel represent the lost land off our modern Atlantic coast. The striking Inch conglomerate in the Old Red Sandstone beds of Kerry, the origin of which is quite unknown, is an extreme example of the same kind.

The fine black mud that darkens so many layers of the Dublin limestone, and even provides material for bricks, was doubtless also derived from the waste of Caledonian land. The Leinster Chain stood there, then as now, looking down upon the sea, with the quartzites and slates of Howth and Bray forming rugged islets a little to the east. The dead Ordovician volcano of Portrane and Lambay doubtless formed another island to the north, with quaint

* *See* Joyce, "A Short History of Ireland," 2nd ed., pp. 207 and 256.

† Compare Sollas, "Geology of Dublin and its Neighbourhood," *Proc. Geol. Assoc.*, Vol. XIII. (1895), p. 107.

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Carboniferous trees gathering on its flanks. The scenery, but for the greater proportion of schist that still overlay the granite core, was essentially that of the present day. The sea-floor then sank, until the waters spread across the Irish midlands, and finally covered the stubborn heights of Donegal. By the opening of the Upper Carboniferous epoch, the Backbone of Leinster was probably entirely submerged.

The striking landscape of early Carboniferous days was thus buried in soft limestone-mud, in shell-banks and coral reefs, and seemed for ever lost to view. Coal-Measure forests stretched across the country, which, in place of mountain ridges, now exhibited a monotony of sandy and swampy flats. The Hercynian uplift, however, altered these conditions; new folds set in, accommodating themselves to the unseen Leinster Chain below; the arch of Coal-Measures and limestone was broken away piecemeal from the buried mass of mountains; and at last the granite itself again began to be revealed.

Denudation at first was slow enough, through the arid Triassic days; but, little by little, the ancient features were restored. Even the great glacial incident at the close of the Cainozoic era only moulded the general outlines, and left undulating mounds of gravel against the severer mountain-slopes. These glacial deposits, which have been largely re-arranged by rivers, are nowadays mostly cultivated, and can easily be picked out, as smooth green areas, under the heather-clad or rocky hills. They often fill the old notches and stream-cuts of pre-glacial days. When we speculate as to the age of this or that valley in the Leinster Chain, we are tempted to ask if any of them can belong to the remote and primary Caledonian drainage system. There must have been original transverse valleys, which became flooded and infilled by the deposits of the Carboniferous sea. Can any of these have survived, to be re-excavated by the streams of later days?

Let it suffice that modern denudation is paring away the Carboniferous Limestone from the antique surface of the hills. The glacial gravels show how vast a quantity of this limestone has been broken up in recent times. And the long-lost Caledonian highland, perhaps reduced to half its former height, emerges along the present lines of foothills, and forms the central granite moors.

When Mr. Weaver,* in 1818, first gave a detailed account of the structure of the Leinster Chain, he traced the junction of the granite and the schists from Killiney southward. He noted the interlamination of granite and mica-slate in Glenmalure, and the cap of the latter rock left behind three thousand feet up on Lugnaquillia. Weaver says that the passes across the range were in his day scarcely practicable, even in summer; and Glenmalure, which is now abandoned, seems then to have been the best of them. The military road, made after 1798, to command the heads of the glens, gave Weaver access to the interior of the range.

In our time, there remain large central tracts which are scarcely ever traversed. They lie remote from any cart-track, and are difficult to visit in a day. But the chief beauty of the mountains lies in the contrasts between the granite and the stratified foothills. The streams that form broad basins on the central moorland give rise to cañons in the jointed rocks of the lower ground. The grey quartzite of the Bray series forms a series of striking summits between the sea and the main watershed; while the splintery Silurian shales, converted along the junction into gleaming mica-schists, weather into rocky slopes, on which the lines of stratification are apparent. Where the granite has eaten into them, as at Luggela, near Roundwood, or on the crest of Douce, or down against the sea in the typical section of Killiney, andalusite and garnet have developed; and a banded structure is often found in the adjacent granite. This was noted by Weaver,* who speaks of it as an approach to gneiss; and Sollas† regards it as due in some places to original flow, and in others to pressure acting on the solid mass, in continuation of the forces that upheaved the Caledonian chain. The granite has been stated to be but little modified by absorption of matter from the walls of its caldron; but it often becomes richer in dark mica near its margins, and assumes here and there the aspect of a composite gneiss. On the whole, however, as Haughton long ago pointed out, it preserves a remarkable uniformity throughout the length of the great mass.

To those who would appreciate the structure of the chain, and the contrasts of scenery on its flanks, the famous Military Road offers a ready introduction. There are some five miles of climbing on it out of Dublin, until we reach the watershed, where we are far up on the old Slieve Roe, a region of heather and high-lying peat, with the crag above Lough Bray prominent before us in the south. Most of the rock-exposures and romantic river-clefts lie in the older Palæozoic foothills; the granite furnishes a gathering-ground for the streams, and its long slopes are only here and there broken by a cirque or some unburied talus. The lower Lough Bray lies in a semicircular hollow, which was once occupied by a residual glacier, and so remained protected while other craggy features disappeared. It is divided from the upper lake by a huge glacial dam, from which we look into a second cirque, carved out originally when the denuding forces were more severe. Already the grass is climbing across the old rock-walls, and the deltas of sand, formed of fragments of felspar and quartz and mica, are spreading out into the lakes. Lough Tay, farther south, has similarly been invaded by the green delta of Luggela; and the fine crag above it belongs to the older order of mountain-landscapes. Only the young granite ranges, like the Mont Blanc *massif*, the Pelvoux, or, in their own small way, the Mournes, retain their array of peaks and pinnacles. Even among the Mournes, or the equally Cainozoic Red Hills of Skye, the decay and rounding-off of the older features are already obvious. The characteristic smooth dome is already prevalent in these wind-swept granite uplands.

If we climb again from the last cottage at Lough Bray, we find, in a waste moorland, the infant Liffey rising as a mountain-stream. It pours down a fine and wooded valley to the east, and then cuts deeply into the Silurian shales. At Pollaphuca, "Puck's Pool," the cascade and chasm are the last highland feature; the river then goes off wandering into the limestone lowlands of Kildare, bends northward at Kilcullen, and finally cuts through the recent and glacial gravels on its way to the sea at Dublin. Mud-brown and commercial though it may be within the city, two miles out it speaks of the unbroken country. At Leixlip (the "salmon-leap"), the name reminds us of the Norsemen, the strong sea-power that founded Dublin; but the water, pouring across the rocky ledges, is still fresh from that larger Ireland which waits for us on the Leinster hills.

* "Memoir on the Geological Relations of the East of Ireland," *Trans. Geol. Soc.*, Ser. I., Vol. V. (1821), p. 117.

* *Op. cit.*, p. 132.

† "Contributions to a knowledge of the Granites of Leinster," *Trans. R. Irish Acad.*, Vol. XXIX. (1891), pp. 492 and 496-502; also "Geology of Dublin," *Proc. Geol. Assoc.*, Vol. XIII. (1895) pp. 108-111.

Conducted by M. I. CROSS.

PROGRAMME FOR 1903.—It is intended in future to devote a larger amount of space to Microscopy than hitherto, and by the co-operation of specialists to publish articles treating on different departments of both the popular and scientific sides. Among those who have promised to contribute are the following:—Mr. Rousselet, "How to Collect Rotifers," and "How to examine Pond Life under the Microscope"; Mr. C. D. Soar, "The Collection, Examination and Preservation of Water Mites"; Mr. Earland, "Coccoliths and Coccoopheres"; Mr. Wesché, "The Mouth Parts of the Tsetse Fly in comparison with those of the Gnat, Gad Fly, etc.," and notes on entomological subjects; Mr. F. Noad Clark, "The Photography of Opaque Objects"; Mr. Sanger Shepherd, "Photo-Micrography in Natural Colours"; and other similar articles will appear.

It is hoped that these new arrangements will greatly increase the value of the microscopical notes, and maintain the interest which has so far been evinced.

As occasion offers, specimens will be offered for distribution as in the past year, and the assistance of readers who may be able to spare interesting material for the purpose will greatly increase the usefulness of this section. It is hoped that some Spongilla, spicules of sponge, etc., will be available for the January number.

POND-LIFE COLLECTING IN DECEMBER.—Severe weather in this country does not, as a rule, set in in December, and the lakes and ponds are not usually frozen over in the early part of the month. The winter fauna has now become more pronounced, but includes quite a number of Infusorians, Rotifers and Crustaceans. The following species of Rotifers have been collected in December in lakes and canals in and round London, some of them in great abundance: *Anuræa aculeata* and *cochlearis*, *Asplanchna brightwelli* and *priodonta*, *Brachionus angularis*, *Diaschiza semiaperta*, *Euchlanis deflexa*, *Melicerta ringens*, *Oecistes crystallinus*, *Limnias ceratophylli*, *Floscularia cornuta*, *Synchæta pectinata* and *tremula*, *Conochilus unicornis*, *Rotifer vulgaris* and *macrurus*, *Polyarthra platyptera*, *Notholca scapha*, *Triarthra longiseta*. Of Crustaceans, *Diaptomus castor* and various *Cyclops* and their larvæ are abundant, whilst Waterfleas die down. A minute red flagellate Infusorian often seems to form the chief food-material of the above lake fauna.

A few of the principal collecting grounds for Pond-life in and near London may be mentioned. The nearest and most convenient available piece of water is the Grand Junction and Regent's Canal, which runs from east to west, on the northern side of London, from Victoria Park to Hanwell, and is readily approachable wherever access can be gained to the towing path. Then all the great parks have a lake, such as Victoria Park, Regent's Park, Hyde Park, Richmond Park, Wimbledon Common, etc., which all afford good collecting grounds. Smaller ponds are found in abundance in fields and commons in and beyond suburban London, and I need only mention a few such places: Epping Forest, Higham Park, Hadley Wood, Totteridge, Hampstead Heath, Ealing Common, Hampton Court, Putney Common.

MICROSCOPE CONSTRUCTION.—The fact that the majority of the British makers of microscopes have to a greater or less extent conformed to an orthodox pattern of microscope stand, would lead one to imagine that for the time being, at any rate, finality had been arrived at, and that the best possible in microscope stands was at the disposal of microscopists. The Continental people, with very slight exceptions, also adhere to a model which is wonderfully uniform, so far as its advantages are concerned, in the different makes.

The "Nelson" model microscope, supplied by C. Baker, was practically the prototype of all the later tripod foot instruments, but is the tripod foot as at present made the best possible for convenient working? What is the real advantage of having straight legs to the front instead of those which may be slightly curved, so that access to the substage and its apparatus (especially in microscopes of small size) may be as conveniently attained as in those microscopes which are built on a horseshoe base?

Microscopists are at last realizing the advantages derivable from a tripod foot, but it is very desirable that disadvantages associated with this pattern should be removed. There is still room for a fine adjustment which shall be carried by the rack-work instead of itself carrying the rack-work portion of the instrument. Swift's "Climax," which he still fits to his "Challenge" and "Paragon" stands, is one of the best devices of this kind, but the laboratory worker wants a fine adjustment milled head in the usually accepted place at the back of the limb.

The mechanical stage certainly needs a greater range of movement, and the milled heads should be below the level of its upper surface. The Continental makers get over this difficulty by supplying controlling heads of very small diameter, which of necessity cannot impart that fine movement which is to be found in the British microscopes. Mr. Nelson many years ago devised a mechanical stage having vertical rack-work movement only, and in order to bring the controlling milled head below the level of its surface, fitted the rack itself beneath the main plate of the stage.

The difficulty that always arises in giving a long movement to a stage is that of the upper lens of the condenser fouling the plates, but this can be obviated, especially with the smaller mounts carrying the achromatic condensers which are so largely coming into vogue.

Then a greater range is required in the body length. I have had specimens sent to me for examination by readers which have been covered with a glass which could only justly be described as attenuated window pane. The wonder is that any self-respecting microscopist could ever spoil his objects by protecting them with such covers. Some I have been unable to examine with a high power at all, while others for critical examination have necessitated an exceedingly short tube-length, sometimes four inches only. This cannot be arranged on the average present day model of microscope.

Then—for amateur purposes especially—it is often felt that there should be a greater interval between the upper surface of the stage and the lower part of the limb of the microscope. The modern microscope is built very closely, and the earlier type, such as the Swift "Challenge" mentioned above, is altogether superior in the comfort it affords in this respect.

A handle by which to lift the microscope has been provided in Zeiss' new photographic stand; this is a convenience which would be much appreciated in other microscopes.

Such matters as these which have been referred to can be more easily incorporated in a microscope of large size than in the popular medium-sized models, but it is to be hoped that the inventive faculty may not become dormant in microscopical matters—there is room for improvement yet.

It is impossible to deny the tribute that is due to Messrs. Powell & Lealand for the prevision which caused them to incorporate many of these features in their large model stand. My own feeling has never been in favour of a coarse adjustment on a bar fitting; it certainly does not meet the needs of every class of worker in a way that the more recently designed stands have done. Could not the better points of the Powell stand be incorporated in other instruments by the exercise of ingenuity?

MICRO. PROJECTION.—A very large number of those people who possess microscopes also have a magic lantern, and a considerable amount of pleasure can be imparted by the projection of micro. specimens upon the screen. Several neat attachments are made to screw into the magic lantern in place of the ordinary lens, and, with suitable condensers and the use of the ordinary micro. objectives, fair results can be secured. It is essential that limelight be used as the illuminant, or, preferably, an arc lamp; anything less than either of these produces dismal results.

XUM

Nothing is more popular than the projection of pond life upon a screen; as this is a subject which, in the exhibiting of the commoner and larger forms, does not call for the use of high magnifications, it can be done with facility. Specimens to be exhibited should be placed in a trough having a small interval between the base and the cover, so as to keep the objects, so far as possible, in one plane. Also the area for free swimming should be a restricted one. Rotifers and some of the smaller subjects could be well shown by placing them in an excavated slip and covering them with a thin cover-glass; compressors and live-cages also have their uses.

But apart from this one subject there is a large range of general objects which would always prove of interest, and the suggestion of selfishness which is frequently attributed to the microscopist, working by himself, would be removed, and an opportunity afforded of giving interesting pleasure to many others.

NOTES AND QUERIES.

C. Upton.—I would dehydrate the lichen in absolute alcohol. Clear in clove oil, then wash away all trace of oil with repeated changes of benzole or naphtha; infiltrate and embed in paraffin wax; cut sections, wash away paraffin with benzole or turpentine and mount in Canada balsam.

Seco.—The photographs you send are very nice and sharp. No. 1 seems to be correctly exposed, but No. 2 appears to be a little over exposed; the detail, however, is nicely shown. The method of ascertaining the magnification when photographing is to project the line of a stage micrometer on the ground-glass screen, and then by measuring the intervals between the magnified lines the magnification can be at once known.

C. Poulter.—Both the specimens you send are *Sertularia operculata.*

G. H. Johnson.—Your query is replied to by the notes which appear in these columns.

H. Taylor.—It is a little difficult to reply to your question without knowing how your objects are mounted. As you incidentally mention pond life, it is to be assumed that you are trying to get a dark ground illumination with objects in troughs. I would suggest that, first of all, you tried to get a black background with an ordinary transparent mounted object such as spicules of sponge or diatoms. With an Abbe Illuminator you will find it necessary to let the front of the top lens practically touch the object glass, and it is essential that the black patch stop that is used shall be of suitable size. Also do you shade the light of the lamp from the upper side of the stage of the microscope? With these precautions there should be no difficulty in obtaining a good black background with the arrangements you make when using the 1-inch or ½-inch, but you must not expect a black background with a ⅙-inch objective. You might get an inferior one by using the Iris Diaphragm at the back of the objective, but it is really not worth the trouble.

O. Heath.—I know of no work that gives the anatomy of the whole order of Insecta; there are special books such as Huxley's "Invertebrata" which gives an account of the cockroach (*Blatta orientalis*), commonly known as the "black beetle," Lowne's "Anatomy and Physiology of the Blow-fly," and Miall's "Harlequin Fly." Packard's "Entomology for Beginners" is an excellent *multum in parvo.* Have you a copy of Kirby and Spence's book on insects? This is at once one of the most informing and interesting books you can read.

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. CROSS, KNOWLEDGE *Office, 326, High Holborn, W.C.*

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

PERRINE'S COMET (1902B).—This comet passed through its perihelion on the morning of November 24th, and has travelled too far to the south to continue visible to northern observers. It was at its least distance from the earth on October 8th, and, theoretically, should have been at its greatest brightness on that date, but comets usually exhibit an increase in light as they approach the sun and the present one appeared fully as conspicuous during the third week of October as it did at any previous date. After traversing the constellations Scorpio, Centaurus and Argo Navis, the comet will return northwards, and, entering Canis Major, will be visible at about the middle of February in a position five degrees S.E. of Sirius, when it will be a little brighter than at the time of its discovery on September 1st. Observations of this comet will be exceedingly numerous and extend over a lengthy period. Many photographs of its aspect when nearest to the earth in the early part of October will also be available for discussion, in fact there will be an abundance of materials both for the computation of the definitive orbit and for the investigation of the physical appearance and changes of the object. There is every reason to suppose that the comet is moving either in a parabola or in an ellipse of great excentricity.

RECENT OBSERVATIONS OF METEORS.—Meteoric observers usually have a busy time in July and August, but in 1902 the weather conditions at many places prevented anything approaching a thorough re-observation of the Perseids or of the multitude of minor showers usually displayed at this productive epoch. Some fine meteors were seen, while the Perseid system appears to have exhibited normal strength and to have given the usual evidence of the easterly motion of its radiant. The following are a few of the positions determined between July 27 and August 12:—

Date.	Radiant. α °	Radiant. δ °	Number of Meteors.	Observer.
July 27—28 ...	28	+ 53	4	A. King, Leicester.
Aug. 1—3 ...	37	+ 55	26	G. M. Knight, London.
Aug. 4—5 ...	40	+ 55½	12	,, ,,
Aug. 10 ...	44	+ 58	9	A. King, Leicester.
,, ...	44½	+ 57	43	G. M. Knight, London.
,, ...	45	+ 58½	15	W. F. D., Bristol.
Aug. 12 ...	47	+ 58½	9	,, ,,
,, ...	48	+ 56½	6	A. King, Leicester.

At Bristol observations were pursued between July 6-16, August 2—14, and August 25—September 7, and 260 meteors were seen. The most active and sharply defined radiants were as under:—

1902.	Radiant. α °	Radiant. δ °	Number of Meteors.	Notes.
July 6—9 ...	299	+ 24	6	Slow.
July 6—13 ...	333	+ 57	6	Slow.
Aug. 24—Sept 7...	74	+ 41	7	Rapid, streaks.
Aug. 26—Sept. 7..	337	+ 81½	10	Rapid.
Sept. 3—7 ...	118	+ 83½	9	Rapid.
Sept. 3—7 ...	30	+ 37	8	Rapid.

FIREBALLS.—On October 15, at 7h. 47m., a fine meteor equal in brilliancy to Venus was seen by Mr. A. King at Newark, Notts. Its aspect was starlike, colour pale green, and duration 2¾ or 3 seconds. It moved slowly along a path of 27 degrees, from 280°—8° to 301°—26½°. The same meteor was observed by Mr. W. Lascelles-Scott at Little Ilford, Essex, who gives the time as 7h. 52m., and says that the object commenced its flight at a point rather higher than midway between the horizon and zenith in N.W. by N. It traversed a path of 105 degrees ending in S.W., and making an angle with the horizontal plane of 30 degrees. The meteor was also seen by Mr. C. B. Holmes, of St. Albans, who describes the path as nearly parallel with the bright stars Vega and Altair, and about 20 degrees to the west. Combining the three observations, the approximate position of the radiant is indicated at 150° + 43°, and the height of the meteor from 62 to 54 miles. It had a long path of about 130 miles, extending from over Usk, Monmouth, to the English Channel, and the velocity was 37 miles per second.

On October 20, 8h. 13m., a meteor about as bright as Jupiter was observed by the Rev. W. F. A. Ellison, of Dublin, with a path from 15° + 46° to 42° + 28°, which it traversed in 1½ seconds.

THE FACE OF THE SKY FOR DECEMBER.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the sun rises at 7.44 and sets at 3.53; on the 31st he rises at 8.8 and sets at 3.57. Winter commences at 7 P.M. on the 22nd, when the sun enters the sign of Capricornus.

Sunspots may now be expected, small groups of spots having appeared from time to time of late.

THE MOON:—

	Phases.	h. m.
Dec. 8	☽ First Quarter	6 27 A.M.
„ 15	○ Full Moon	3 47 A.M.
„ 21	☾ Last Quarter	8 0 P.M.
„ 29	● New Moon	9 25 P.M.

The moon is in apogee on the 2nd and 29th, and in perigee on the 15th.

Several bright stars suffer occultation during the month; of these the occultation of ζ^1 Piscium on the 10th occurs at a convenient time, the times of the others are somewhat inconvenient.

Date.	Star Name.	Magnitude.	Disappearance. Mean Time.	Disappearance. Angle from N. Point.	Disappearance. Angle from Vertex.	Reappearance. Mean Time.	Reappearance. Angle from N. Point.	Reappearance. Angle from Vertex.	Moon's Age.
			h. m.	°	°	h. m.	°	°	d. h.
Dec. 4	β Capricorni	3·4	7 38 P.M.	38	4	8 33 P.M.*	286	248	4 18
„ 10	ζ^1 Piscium	4·2	7 8 P.M.	74	84	8 22 P.M.	238	232	10 18
„ 14	δ^1 Tauri	4·0	1 53 A.M.	86	51	2 56 A.M.	268	228	14 0
„ 14	δ^2 Tauri	4·7	2 27 A.M.	110	71	3 23 A.M.	245	205	14 1
„ 15	120 Tauri	5·3	4 52 A.M.	13	332	5 0 A.M.	356	315	15 3
„ 16	λ Geminorum	3·6	5 49 P.M.*	64	98	6 32 P.M.	302	340	16 16

* Star below horizon.

THE PLANETS.—Mercury is unobservable, being in superior conjunction with the sun on the 12th.

Venus is an evening star, but sets too soon after the sun to be observed.

Mars rises about midnight. His path is in Virgo, and at the middle of the month he is near β Virginis. He is in quadrature with the sun on the 24th, when the gibbosity is a maximum, 0·90 of his disc being illuminated. The angular diameter of the planet is about 6″·5.

Jupiter is observable throughout the month in the early part of the evening. At the beginning of the month he is on the meridian at sunset, and sets about 8.45 P.M. Near the end of the month he sets at 7.30 P.M. His brilliance is now waning and his diameter diminishing, the polar and equatorial diameters being 33″·6 and 36″·0 respectively on the 14th.

The positions of the satellites as seen in an inverting telescope at 5.30 P.M. are as follows:—

Day.		Day.	
1	4 1 ○ 3 2	17	3 4 2 1 ○
2	4 3 2 ○ 1	18	4 3 ○ 1 2
3	4 3 1 2 ○	19	4 1 3 ○ 2
4	4 3 ○ 1 2	20	4 2 ○ 1 3
5	4 1 ⊙ 3	21	4 1 ○ 3 ●
6	4 2 ○ 1 3	22	4 ⊙ 3/2
7	4 ○ 2 3 ●	23	4 3 2 ○ 1/2
8	1 ○ 3 2 ●	24	3 2 1 4 ○
9	3 2 ○ 1 4	25	3 ○ 1 4/3
10	3 2/1 ○ 4	26	1 3 ○ 2 4
11	3 ○ 1 2 4	27	2 ○ 1 3 4
12	1 ○ 3/2 4	28	1 2 ○ 3 4
13	2 ○ 1 3 4	29	○ 1 3/2 4
14	1 ○ 3 4 ●	30	3 ⊙ 4 ●
15	1 ○ 3 2/4	31	3 2 1 ○ 4
16	3 2 ⊙ 1		

The circle (○) represents Jupiter; ⊙ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc, or in the shadow. The numbers are the numbers of the satellites.

Saturn sets too soon after the sun to be observed.

Uranus is in conjunction with the sun on the 14th, and is therefore unobservable.

Neptune is observable throughout the night. About the middle of the month he rises at 4.30 P.M., and is on the meridian at midnight, being in opposition to the sun on the 14th. On the 1st of the month he is to be found midway between η and μ Geminorum, and 17′ south of the line joining the two stars, whilst on the 31st he is exactly 14′ south of the star η Geminorum.

THE STARS.—The positions of the principal constellations near the middle of the month at 9 P.M. are as follows:—

ZENITH . Perseus, Cassiopeia.

SOUTH . Andromeda, Aries, Pleiades, Cetus; to the S.W., Pisces; to the S.E., Taurus, Orion, *Sirius* rising.

WEST . Delphinus, Cygnus, Pegasus; Lyra to the N.W.

EAST . Auriga high up, Canis Minor (*Procyon*); Leo rising in the N.E.

NORTH . Ursa Major, Ursa Minor, Cepheus, Draco.

Minima of Algol occur on the 1st at 5.15 P.M., 16th at 1.20 A.M., 18th at 10.9 P.M., 21st at 6.58 P.M.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of November Problems.

No. 19.

Key-move.—1. B to B8.

As there is a dual in the composer's main variation, duals alone need be mentioned here. After 1. . . . B to Ksq there is a dual by 2. Q to R5. or 2. P to K5ch; after 1. . . . B to Q2, by 2. P to K8 (Q), or 2. P to K5ch; and after 1. . . . B×KtP, a quadruple by 2. P to K5ch, or promotion of the Pawn to Q, R, or Kt.

No. 20.

Key-move.—1. Q to B5.

If 1. . . . P×Kt, 2. P×P, etc.
1. . . . P to K3, 2. Kt to B3, etc.

After 1. . . . P×P, there is a dual by 2. Q to Kt5, or 2. B to B4.

No. 21.

The author's solution is 1. . . . R to QB7; but there are two others commencing with 1. . . . Kt to QKt7, and 1. . . . Kt to K4.

SOLUTIONS received from W. Nash, 4, 4, 6; W. Jay, 6, 5, 6; G. Woodcock, 4, 4, 4; C. Johnston, 6, 4, 6; "Looker-on," 6, 5, 6; J. W. Dawson, 5, 4, 4; Lt.-Colonel Damania, 4, 4, 4; Eugene Henry, 0, 4, 4; J. S. Davis,

0, 0, 0; W. H. Jones, 4, 0, 4; "Alpha," 4, 0, 4; "Tamen," 5, 4, 4; G. A. Forde (Capt.), 4, 0, 4.

J. W. Dawson.—You are quite correct. I regret the mistake in simple addition.

Lt.-Col. Damania.—A dual is a choice of two equally effective continuations on White's *second* move, a triple of three, etc.

W. H. Jones.—Probably you will find that Q to R6, in No. 20, is defeated by 1. . . . P × Kt.

Eugene Henry.—After 1. . . . Q to R2, in No. 19, Black is not compelled to capture the Queen.

J. S. Davis.—Perhaps you could get some friend to show you why your solutions are incorrect.

"*Tamen.*"—I do not understand what you mean by "a problem in lettered notation, of E. R., or the writing from E. R." Perhaps you could explain more clearly.

Mr. J. W. Dawson's score in the Solution Tourney should have been 74, instead of 72, as stated last month.

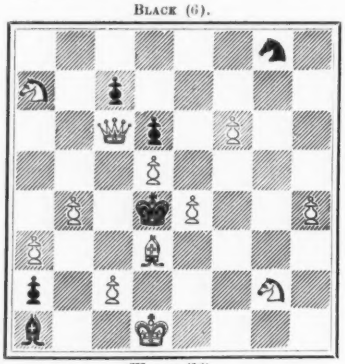
Mr. H. F. Griffiths, 17, Alwyne Road, Canonbury, N., would like to hear of an opponent for correspondence play. Mr. Griffiths describes himself as a medium player.

PROBLEMS.

No. 22.

"By indirection seek direction out."

BLACK (6).



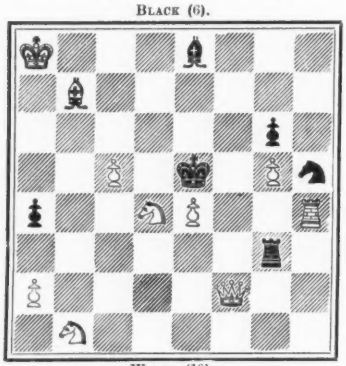
WHITE (12).

White mates in three moves.

No. 23.

"Seeing the thing through."

BLACK (6).



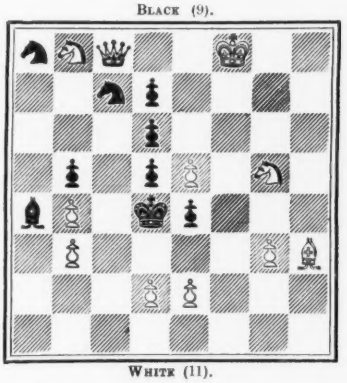
WHITE (10).

White mates in three moves.

No. 24.

"Weighty."

BLACK (9).



WHITE (11).

White mates in three moves.

CHESS INTELLIGENCE.

The Third Monte Carlo International Tournament will take place early next year. It will probably be a two-round competition, the players already invited being Lasker, Marco, Maroczy, Mieses, Pillsbury, Schlechter, Tarrasch, Tchigorin, and presumably Janowski. Dr. Lasker is now engaged on a chess tour in the United States. Mr. Pillsbury is at present in London, and has recently made some important contributions to the theory of the openings. By some very ingenious analysis he has once more demonstrated the soundness of the "Falkbeer Counter Gambit," for some time apparently demolished by Charousek. On the other hand, he has discovered a simple way of dealing with the "Gledhill" attack in the French Defence, by means of which Black gets out of his difficulties at an early stage and retains his numerical superiority.

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